CLINICAL
LOOKING
GLASS®

Study Designer - Clinical Looking Glass

A Self-Study Guide

Eran Bellin Version 30

October 27, 2015

Contents

Pre-class Assignments 3
Study Designer 3
Analytic Methods 5
Time to Outcome 7
Exercise #1 Pneumonia Readmit Study 9
Challenge Problem #1 34
Tutorial 16: Importance of Cohort Index Date on the meaning of a Study 44
Time to Outcome Advanced Method 50
First Recapitulate Results of Simple Method with Advanced Method 50
Complex TTO Examples requiring an Advanced TTO 74
Summary – Utility of Advanced Method TTO 106
List Method Looking only at the attributes of the cohort 107
List Method When you want to see attributes that were not used in the building of the original cohort 115
List Method asking for **all** results not just the earliest or last 153
Tutorial 24: List Method Long view 153
Next Steps 168

Pre-class Assignments

Read Pages 3-8

Build Cohorts on P. 7

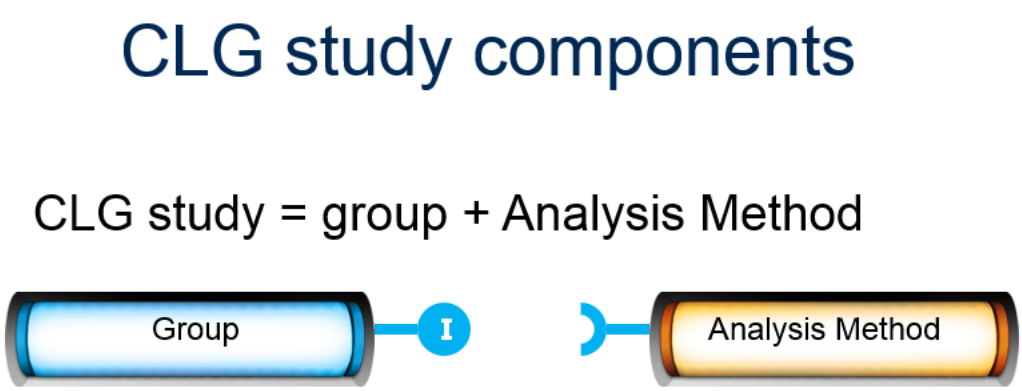
1. Tutorial 11: Temporal Relativity in Cohort Builds (ppt3)
   https://www.youtube.com/watch?v=LHK9uLvDyoU
2. Tutorial 12: The cohort as an Analytic Object (ppt 4)
   https://www.youtube.com/watch?v=i2jCBlcPQu0
3. Tutorial 13: Introduction to Study Designer ppt (5)
   https://www.youtube.com/watch?v=qvPZonY05AU

Study Designer

Event Canvas allows you to build a cohort or an event collection. Both Cohorts and Event Collections are called Groups. For ease of presentation, we will use the word Groups rather than cohorts or Event Collections.

Once you have built your groups (cohorts or event collection), you will want to perform some analysis on the members of the group. The collection of analysis rules applied to the group members is called a method.

When you have both a group and a method you have a study.



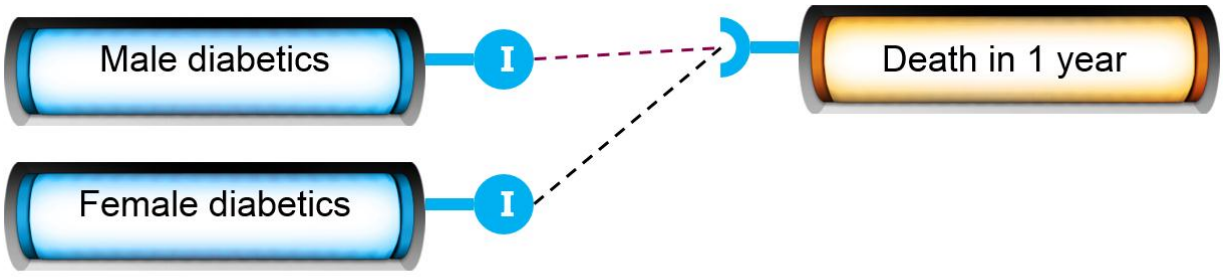
You notice the "I" on the image for the group. This is to remind you that each member of the group has an index date:time from which the analytic method measures elapsed time. You learned about the within temporal operator on event canvas and you will be able to build in Study Designer Analytic Methods that will measure outcomes within a certain amount of elapsed time from the index date from each individual member of the group.

Once you build a study, you will see how tightly bound the group and its analytic method is.

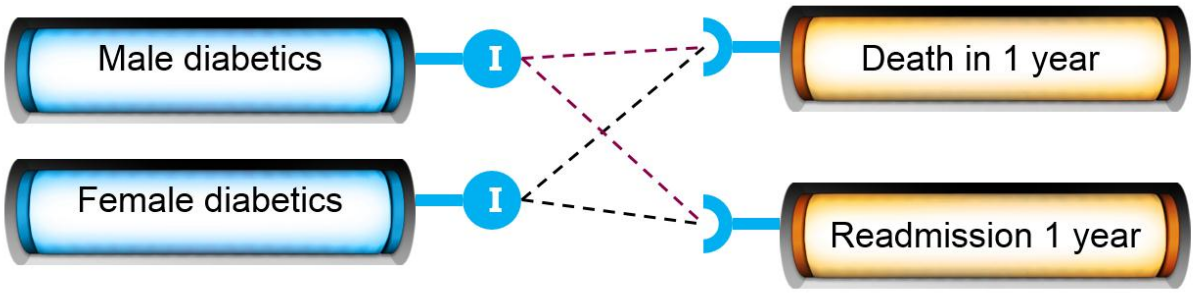
They can be bound through the index date of the group. How much time has elapsed from the index date to some outcome.

Also they can be bound with a “When IN” duration operator. If the Group Member is identified by a “durational event” like admission, the Analysis Method can relate to the individual group member through the duration of the group itself. For example you can find all the cardiac echoes (Analysis Method cardiac echo) “When In” the Group’s admission event.

When you want to compare outcomes between groups, you put more than one group in the study.



If you want to do additional analyses in a study, you add more methods.



So a study can have more than one group and more than one method.

In this Self-Study guide you will learn how to build studies composed of multiple groups and multiple methods.

Analytic Methods

There are three analytic Methods available to you in CLG. These Methods will provide you with most of what you will need to extract meaningful information. In addition, they will also allow you to export data so you can build more complex models in the statistical package of your choice.

The three Analytic Methods are provided below:

1. List method – provides for each cohort member data on the index event, demographics at the time of the index event (such as age, race, gender), and information on any other event you specify in the race track paradigm (to be explained). For example, your cohort could have hospital admission as its index event, but your list could include the last creatinine before admission, or the first hgba1c in the preceding 12 months.

2. Time to outcome method – calculates the amount of time elapsed from the index date of the cohort member until some target event you define.

   For example,

   You could have as index event = hospital discharge and then target outcome event = all cause hospital admission. This is a readmission analytic.

   CLG would calculate the elapsed time from the discharge to first admission and summarize this elapsed time in a graph and table.

   Clinical Looking Glass would also count all the admissions after the discharge (not just the first), divide this number by the number of patient days of follow up in the cohort to calculate an incidence density of all admissions in the specified follow up time.

   Follow up time censored by death or by running out the calendar (to be described) is managed automatically using the technique of the Kaplan Meier statistic.

3. Time in Range Method – for continuous variables like INR, or glucose, CLG could follow multiple lab values for a specific lab test for each cohort member from the index date:time forward for a defined period and calculate the percent of time spent in prespecified ranges of laboratory test values. For example, you could follow the INR values of a cohort of patients from their index date for a year and summarize the quality of their anticoagulation by the time spent in the ranges of 1-1.9 (bad low), 2-2.8 (good), 2.9- infinite (bad high).

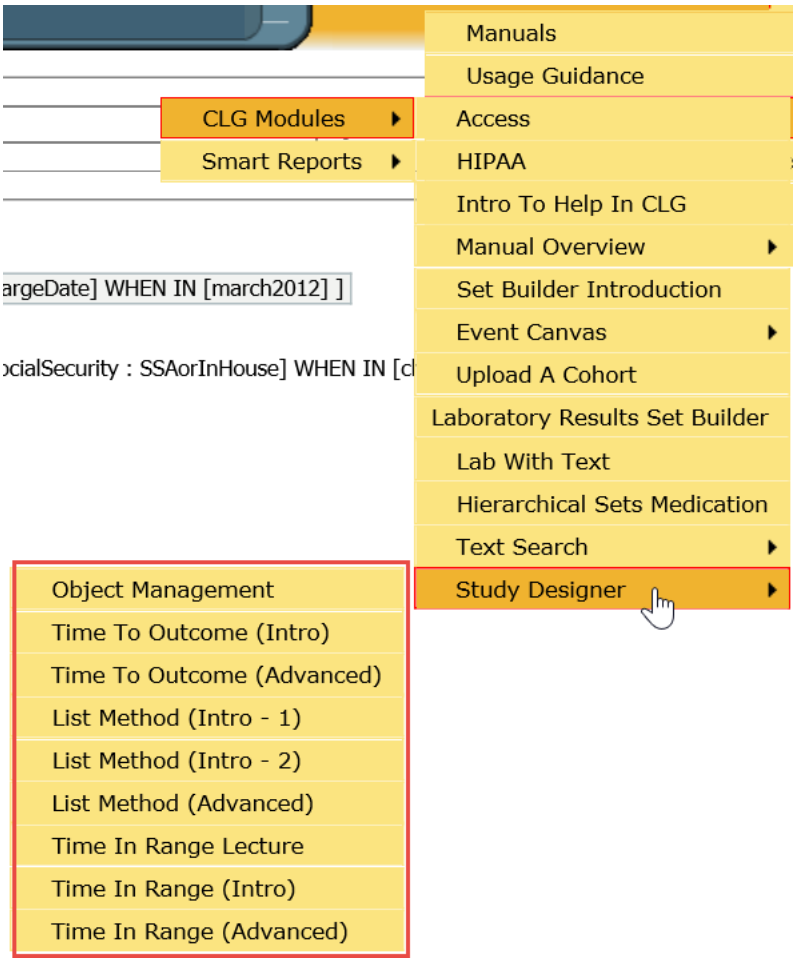
In this Basic CLG literacy course, we will cover the first two analytic patterns leaving to you in self-study video tutorials and manuals to learn the third analytic method.

During this course watch 1-7: For study designer:

1. Object management
2. Time to Outcome Introduction
3. Time to Outcome Advanced
4. List Introduction
5. List Intro 1
6. List Intro 2
7. List Advanced

The following are optional for advanced students.

8. TIR lecture see if lecture is adequate and if it needs to be enhanced.
9. TIR (Introduction)
10. TIR (Advanced)



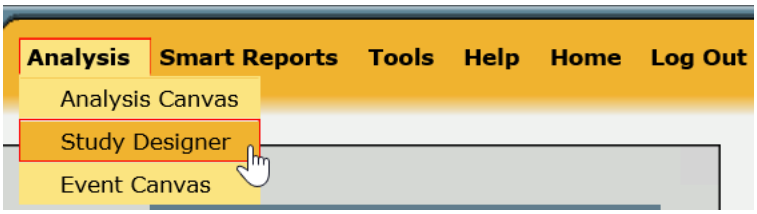
Time to Outcome

1. Tutorial 14: Study Designer Time to Outcome Simple Method
   https://www.youtube.com/watch?v=Mw3XVDeWFHw&index=14&list=PLf7raPnmlLOeAWU2cNf2jIMDRqQuUTCum

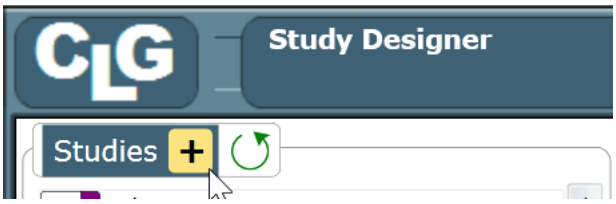
Let's consider a readmission question. For all the patients with pneumonia from the moment of discharge alive, how long did it take for the patients to get readmitted? Readmission for any cause.

The method required is a time to outcome analysis.

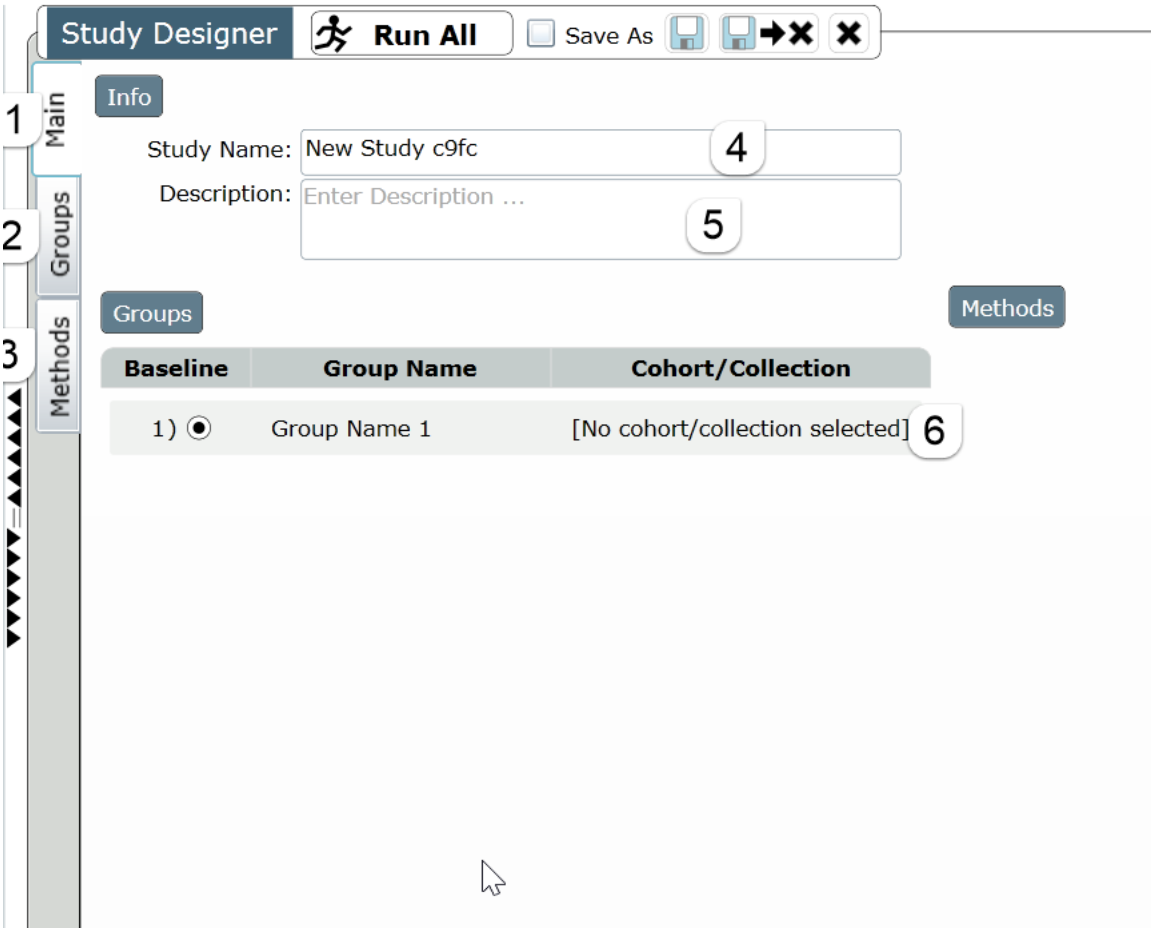
First let's open up study designer:



Study designer opens up.



Now left click on the (+) sign to create a new study.



On the left hand side of the study designer canvas you see three tabs. Each tab represents a canvas within this particular study.

1- Main - this is the Main Canvas of this study where you name and save the study. The Main Canvas is a summary canvas for the study. It will ultimately include the name of the groups on the left hand side and the name of all the methods you have built in this study to act on those groups. The methods will be listed on the right hand side of the page.

2- Groups – This canvas has the names of each group you are including in the study. These are the groups upon which the study methods are applied. A group can either be a cohort or an Event Collection. Each group member is anchored at his index date from which elapsed time is measured.

3- Method – This is the Method Canvas. You are allowed to build multiple methods on this canvas as will be demonstrated. These methods are composed of three types Time to Outcome, List, or Time in Range.

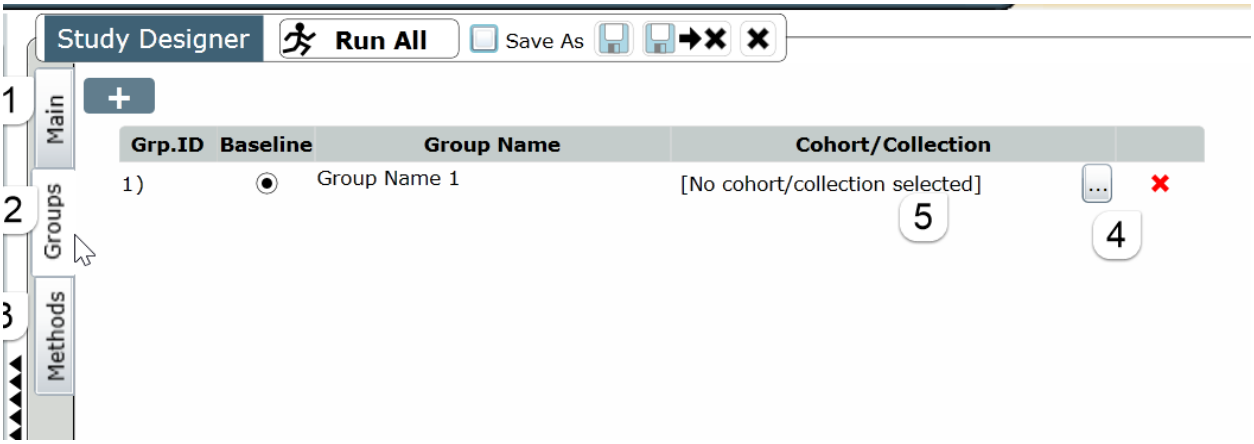
Exercise #1 Pneumonia Readmit Study

Give the study a name "Pneumonia Readmit"

Optionally write a description

Click on Groups tab (Canvas) (2)

The study designer canvas switches from the Main Study designer Canvas to the Group Study Designer Canvas. The Group tab turns white and the Main tab grays out.

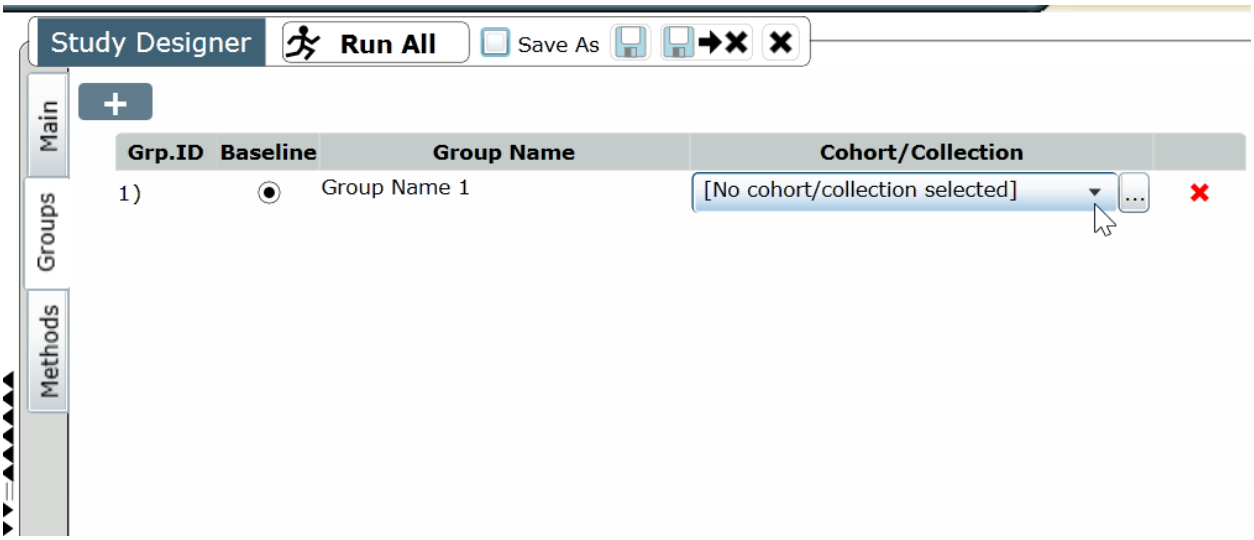


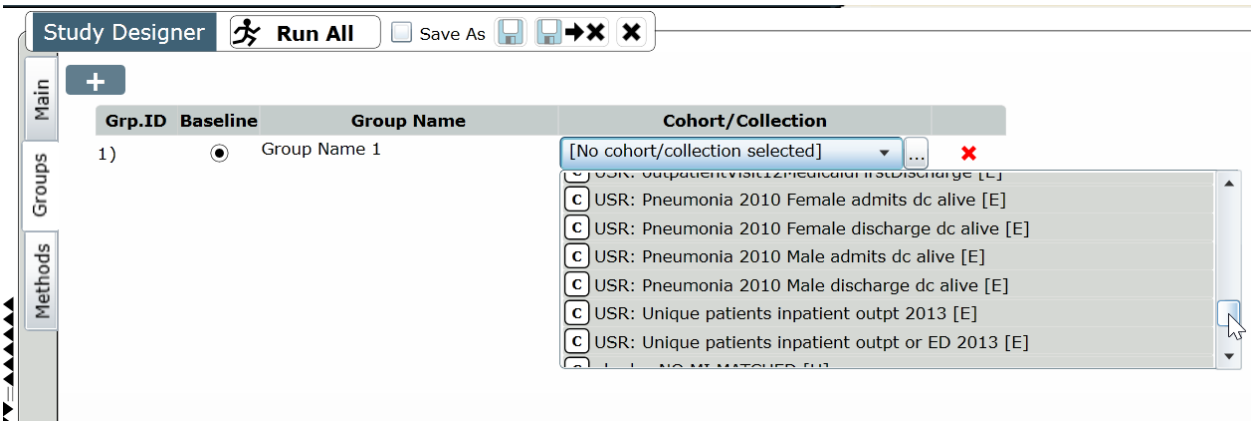
2 – note Groups tab is White indicating it is the active canvas layer of the study designer.

4 – If you want to build a new group (cohort or collection) you can click on the

"three dotted button". This will open up the event canvas, let you build your cohort or collection and then you can return to the study designer. I prefer to build my cohorts and collections first in the event canvas and then just select them from the drop down that becomes available when you Left click on [No cohort/collection selected] 5.

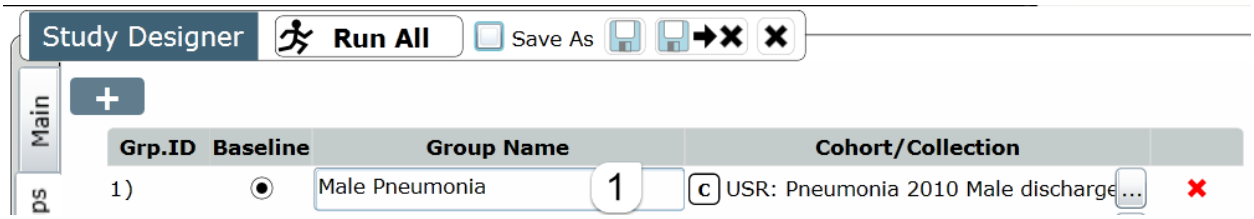
Hovering over [No cohort/collection selected] 5 will activate that phrase causing a box to appear around it and a downward arrow to appear on the right. Left click on the downward arrow and you will see all the cohorts and event collections you have built available for selection.



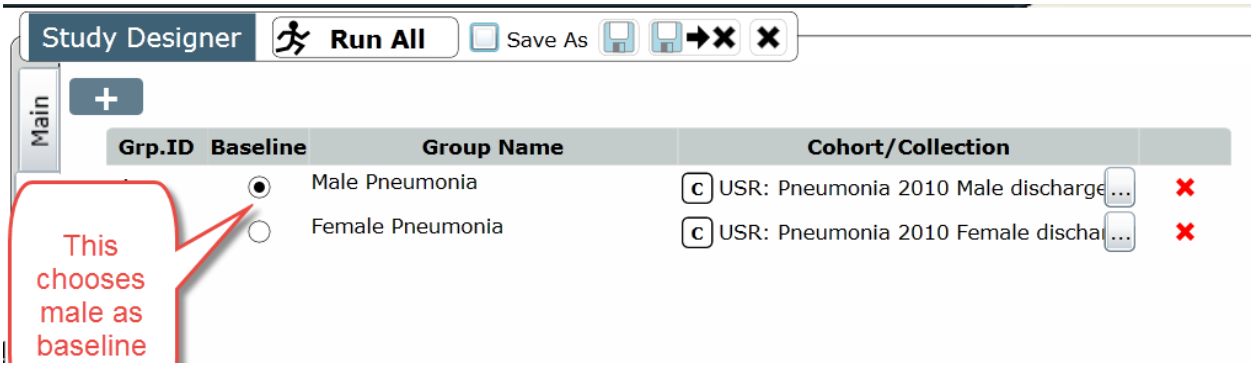


Use the vertical slider until you find the pneumonia cohorts you built before. We want male and female pneumonia patients with primary diagnosis of pneumonia discharged in 2010 alive (not expired).

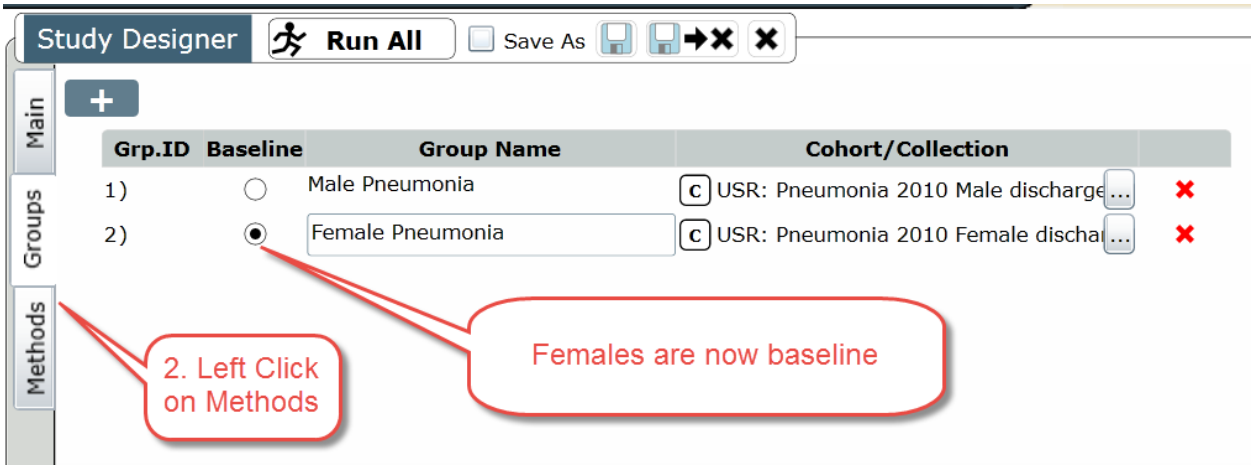
Highlight the desired cohort and then put in a group name that will be used by the program to refer to this cohort (or event collection) in its graphs or summary reports.



1- Type in Male Pneumonia
2- Left click on (+) to add another group



The way we have set this up, we have made males as the baseline. But I want to compare the relative risk of admission of males to females so I have to change this to Female baseline by clicking on the baseline button near the female cohort.



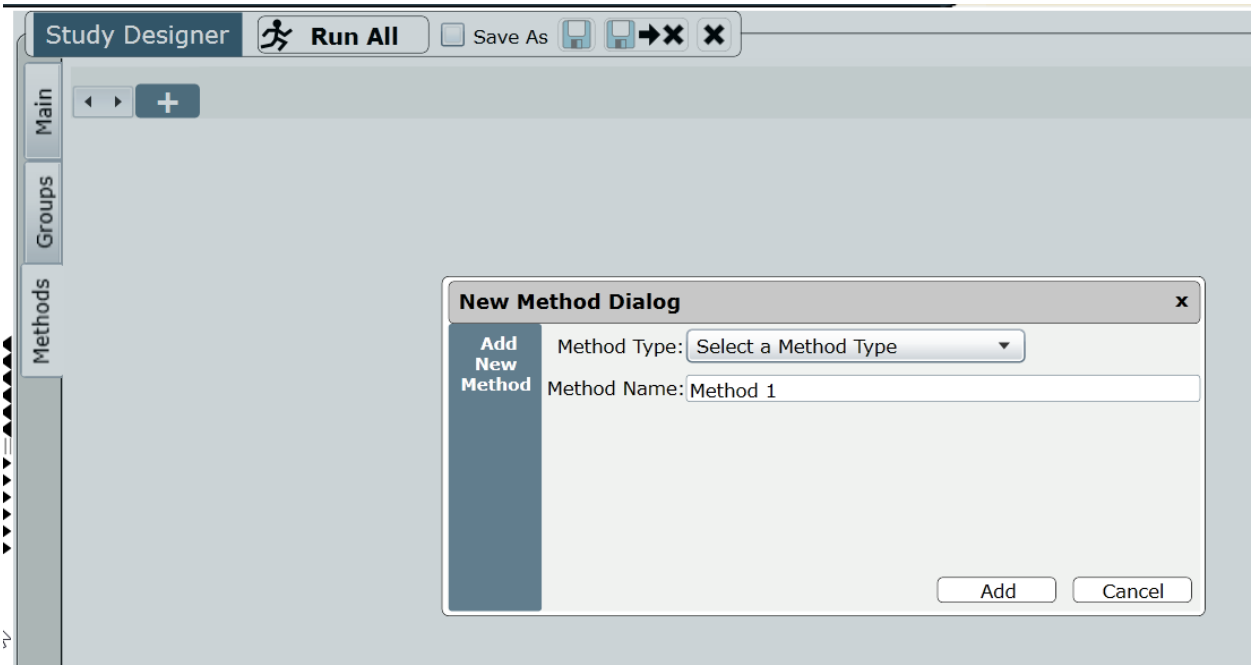
We have successfully, chosen the two groups for study - the male and female pneumonia cohorts of 2010. We have successfully established that the females will be the baseline. We have successfully named the groups so any table or graph created by study designer will be clear. We have finished with the "Groups" canvas of Study Designer.

Now we have to tell study designer to switch to its "Method canvas" so we can paint the rules for the method we are about to select. Left click on Methods tab.

We are now on the Methods canvas of the Study Designer. Note how the Methods tab (2) is now white (active) and the Groups tab is now grayed out.

The Methods canvas has no method yet. We will add our first method by left clicking on the (+) sign.

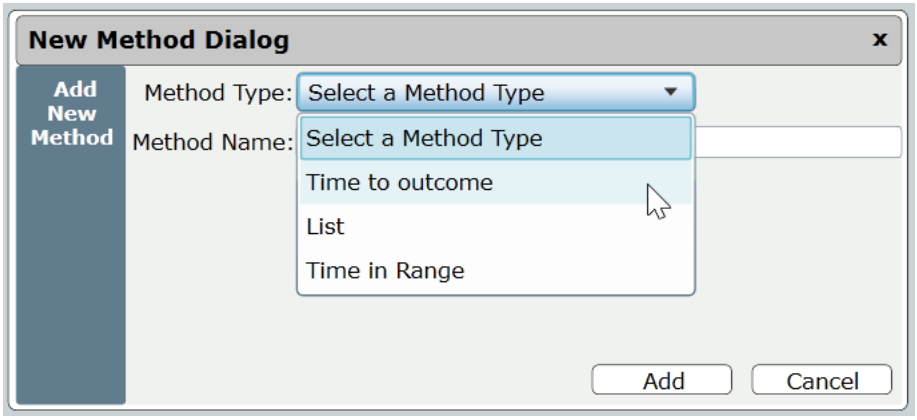
Please note, we will be able to add many methods on the method canvas, but, of course we will start with our first.

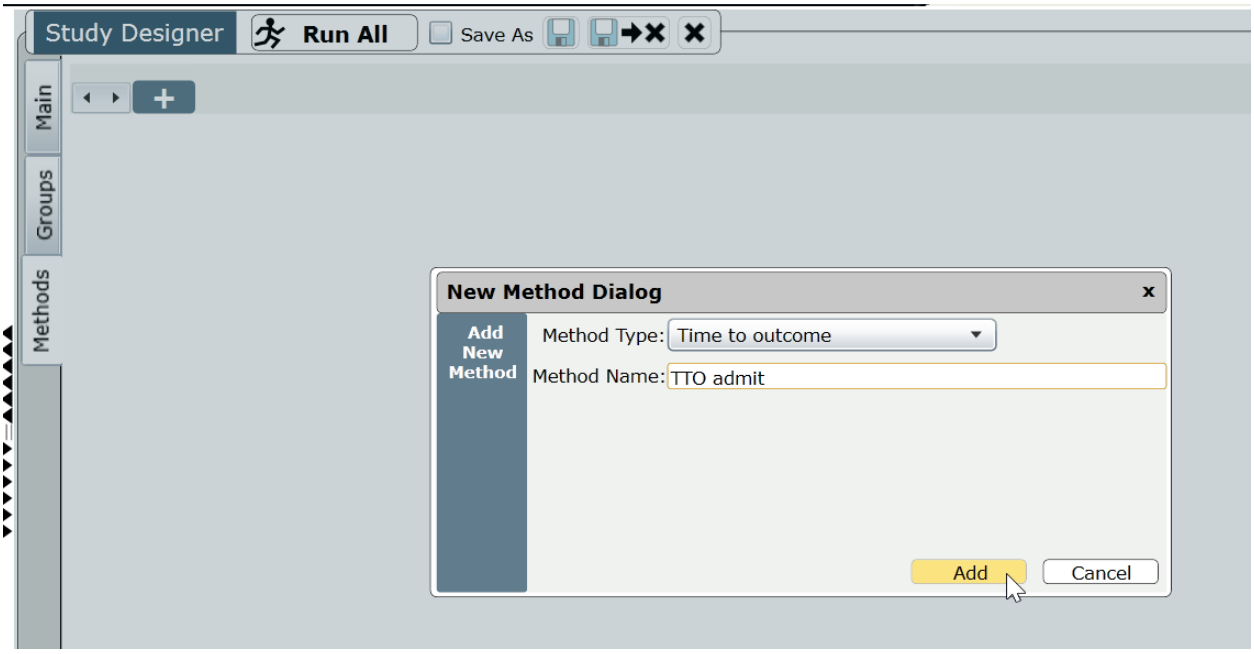


A dialog box opens up allowing us to choose from the drop down menu from the three method types available to us and allowing us to name the method. Naming is important if you are going to have many methods in your study.

Left click on the downward arrow next to “select a method type”.

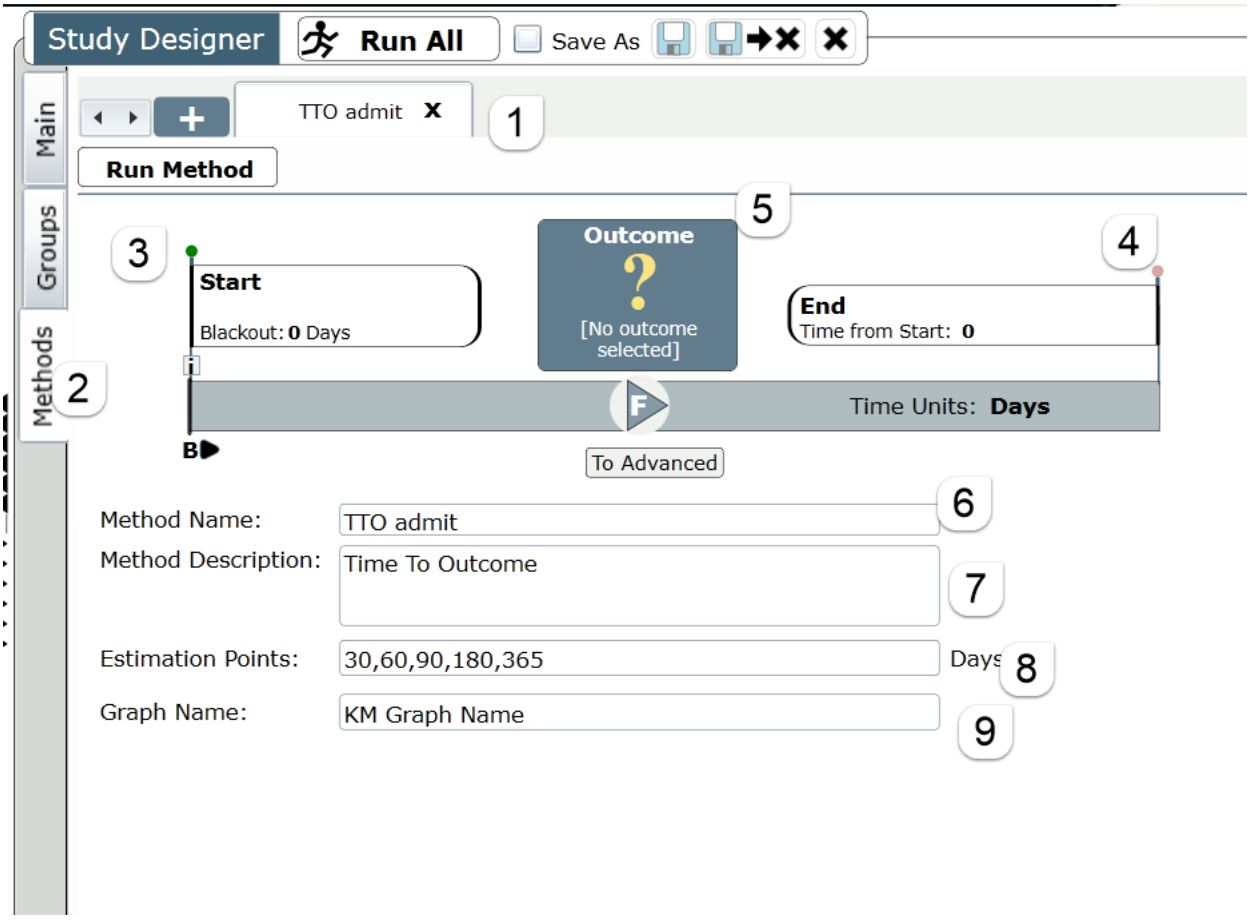
We will choose Time to outcome from the method type and we will name the study “TTO admit” in recognition of the fact that we are going to evaluate the amount of elapsed time to first readmission from live discharge of male and female pneumonia patients in 2010.





Left click on Add.

Notice at the top line next to the (+) sign a new tab has appeared. This tab is the “TTO admit” outcome canvas. You are able now to instruct study designer how you want the “TTO admit” method to function.



I will now give you a tour of the "TTO admit" Method canvas. Numbers are keyed to the image above.

1- Note how the tab telling you are on the TTO admit canvas is white. When you have many methods, they will be added next to this tab but will be grayed out if not active. When active, you can modify the criteria. However, until you run the study the results do not change.

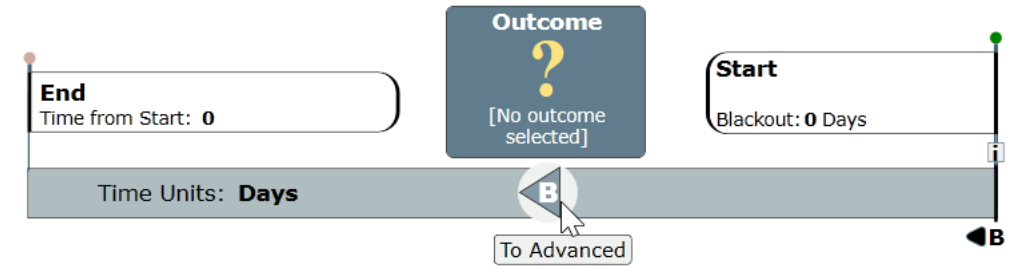
2- Note the method tab is also highlighted (White). This is a visual cue that you are on a method canvas (not a group, not a main). The top row "TTO admit " tab tells you that within the method canvas you are in the "TTO admit "canvas. These two tabs the vertical (methods) and horizontal (TTO admit) orients you to where you are in the study designer. Take a few moments to reinforce this in your mind. Some students click through this quickly and then find they have lost their orientation. By spending a few minutes with this paragraph, you will become comfortable knowing where you are in study designer.

3- Paradigm 3-4-5
The paradigm we are showing you for data entry in study designer is the "racetrack".

Every patient in each cohort has his own index date, so each one has his own "start flag" beginning on that index date.

We are in what is called the simple mode of study designer.

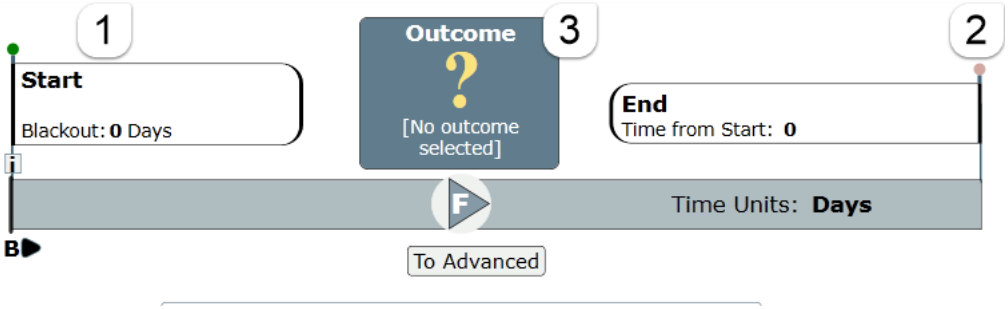
We follow that patient forward in time (note the F on the racetrack) to the end of the race the end of time specified in the stop flag (4). If you want to go backwards in time you left click on the F button on the racetrack and the flags reverse and the racetrack has a big B instead of F



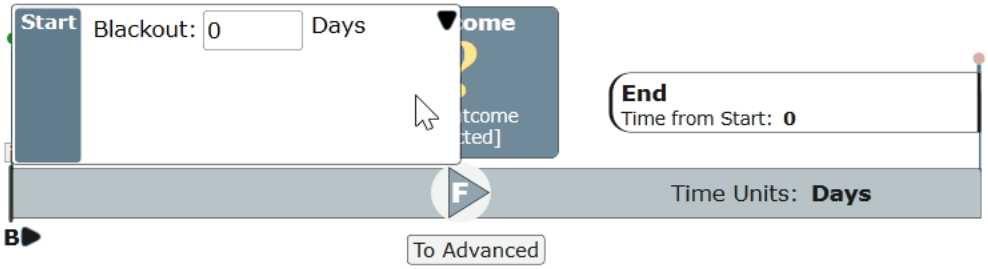
The outcome (5) we are looking for is placed in the outcome image (5).

Let's review each image on the racetrack and input the relevant data for our time to outcome – admission analysis.

First left click on the start flag (1)



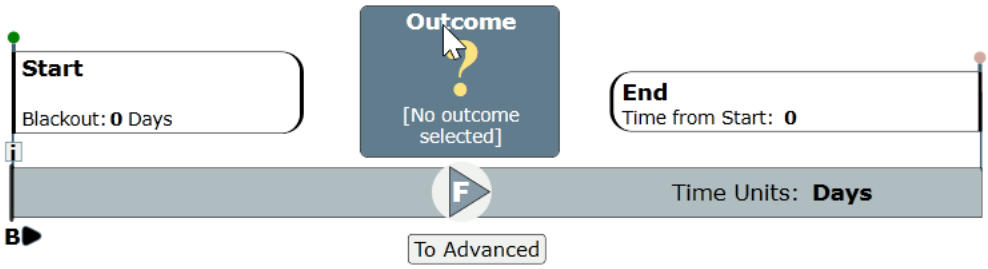
The start flag control opens up:



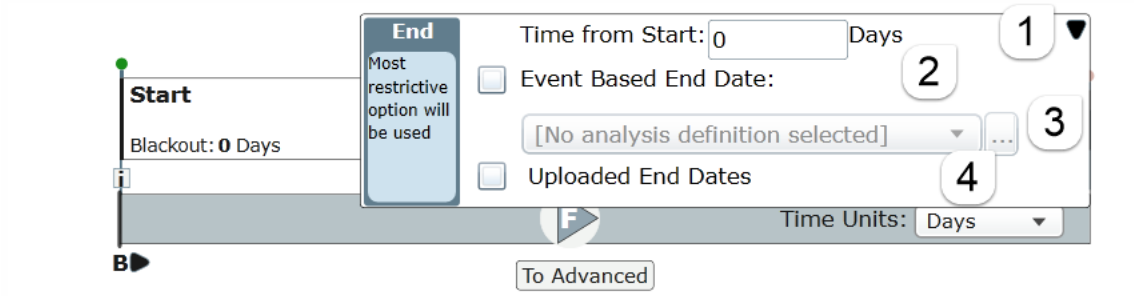
You are given the option of entering a number for blackout days. All analyses begin at the index date and in this image go forward in time to look for an outcome. In some situations you do not

want to count any outcome in the first 2 days. If that is the case, you tell study designer that you want a blackout day number of 2. Study designer will then only count time and outcome that occurs after the 2 days have elapsed from each index date. It is similar to resetting each cohort member's index date to date+2 days.

In our case, we want to count admissions if they happen immediately so we will not enter any blackout day. We will left click on the downward arrow in the start box to restore the image to its baseline.



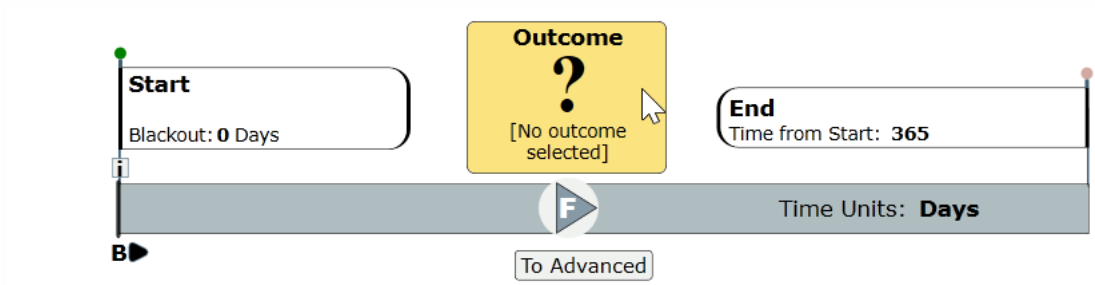
Now, we will left click on the End flag.



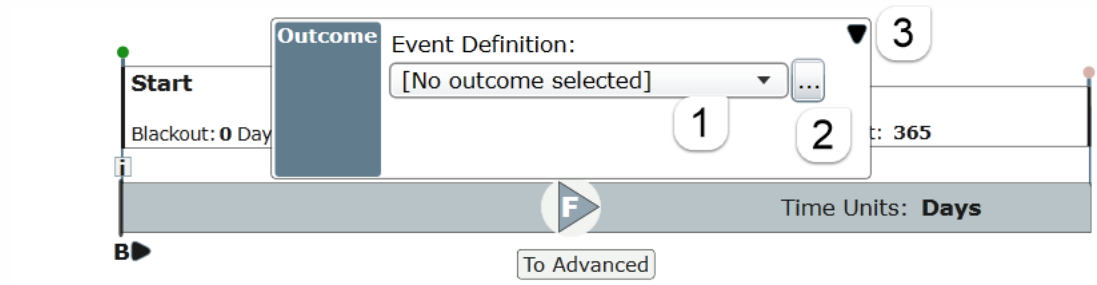
We want to look at time to admission up to 365 days so we will enter into (1) 365 days. In fact, we want information on 30,60,90… days as well and we will ask for that later. Right now we are defining the outer limit of time by which we want to detect a readmission.

In this intro course, we will not cover 2,3,4. However, these controls give you exquisite ability to censor follow up time by an intercurrent event (event based end date represented by an analysis definition) or by an uploaded end date.

Close the end arrow by left clicking on the downward arrow.



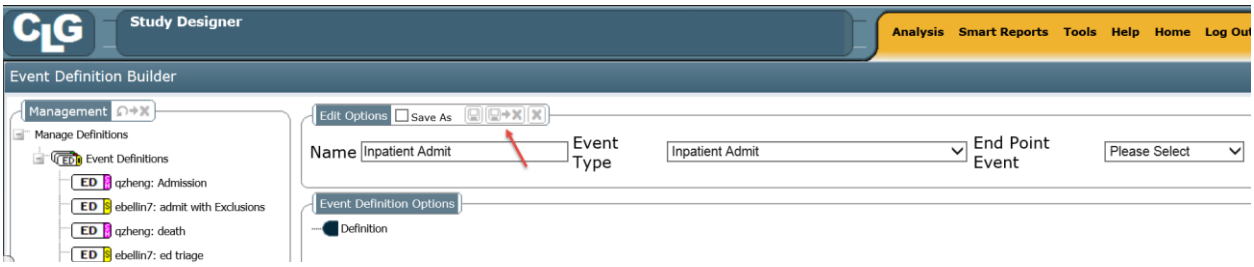
Now we have to define the outcome of interest. Hover over the Outcome box and note how it turns active by changing color to yellow. Left click on the Outcome Box.



The box opens up and gives you two choices.

1- If you already have a defined event definition from a previous study, the system will let you left click on the downward arrow and select it.
2- If you do not already have a defined event definition the "three dotted button" opens up a canvas and allows you to build the outcome "event".

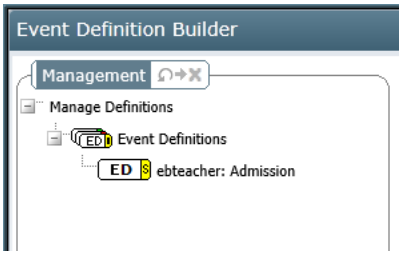
Let's Left click on the three dotted button and see the canvas and build an admission event.



Note: this canvas - event definition builder does not have any time element and does not have any quantity "all", "Earliest", "Latest". The reason for this is that the "Event definition" is used in the simple version of Study designer where the racetrack paradigm imposes the notion of earliest on the event and the time is provided by the user in the end flag

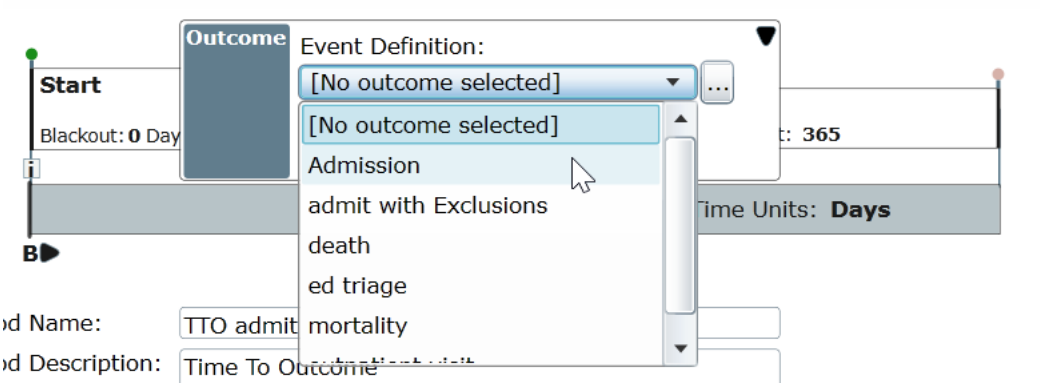
Left click on Save and Exit

The management pane now records the admission event.

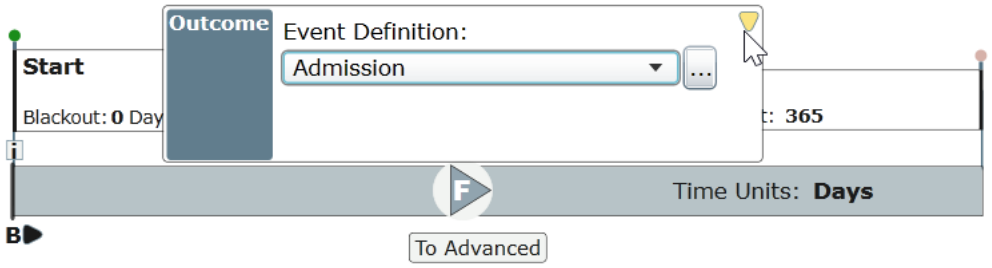


Now Left click on the close button at the top of the “Event Definition Builder management pane” and return to the study designer.

Left click on the downward arrow next to “[No outcome selected]

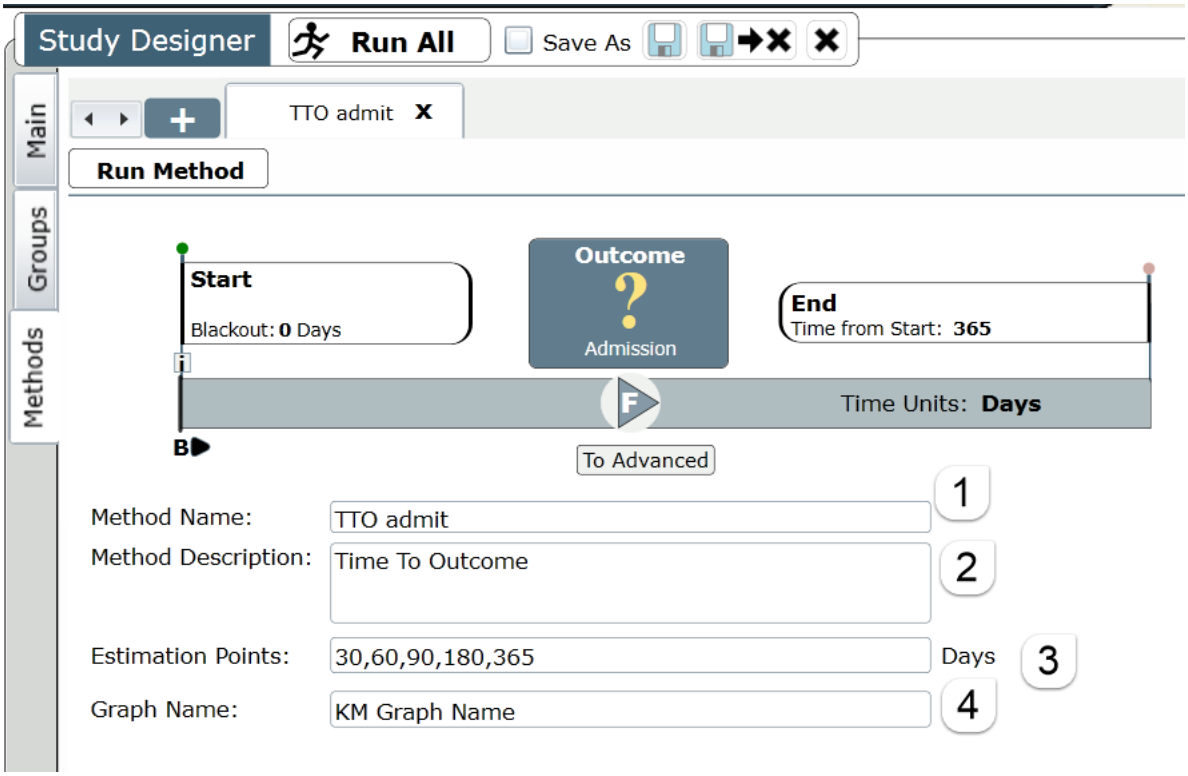


Left click on Admission.



Hover over the outcome’s box downward arrow, turning it yellow, and then left click on this downward arrow.

Yielding:

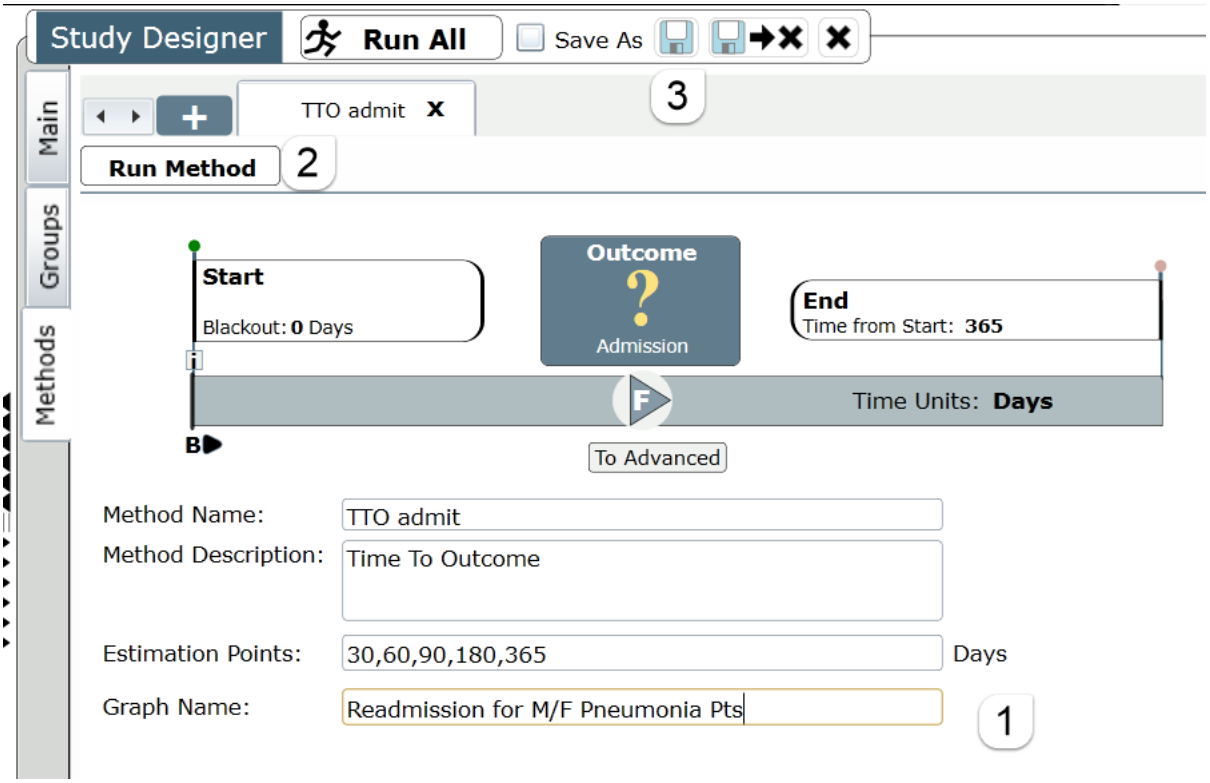


All the following umbers refer to their counterpart in the above graph.

1, 2 accept the defaults

3- Estimation days seem appropriate 30,60,90,180,365 days. This will build a table of cumulative incidence first admission by day 30, 60,90…..

4- Rename the graph name to something that will be meaningful “



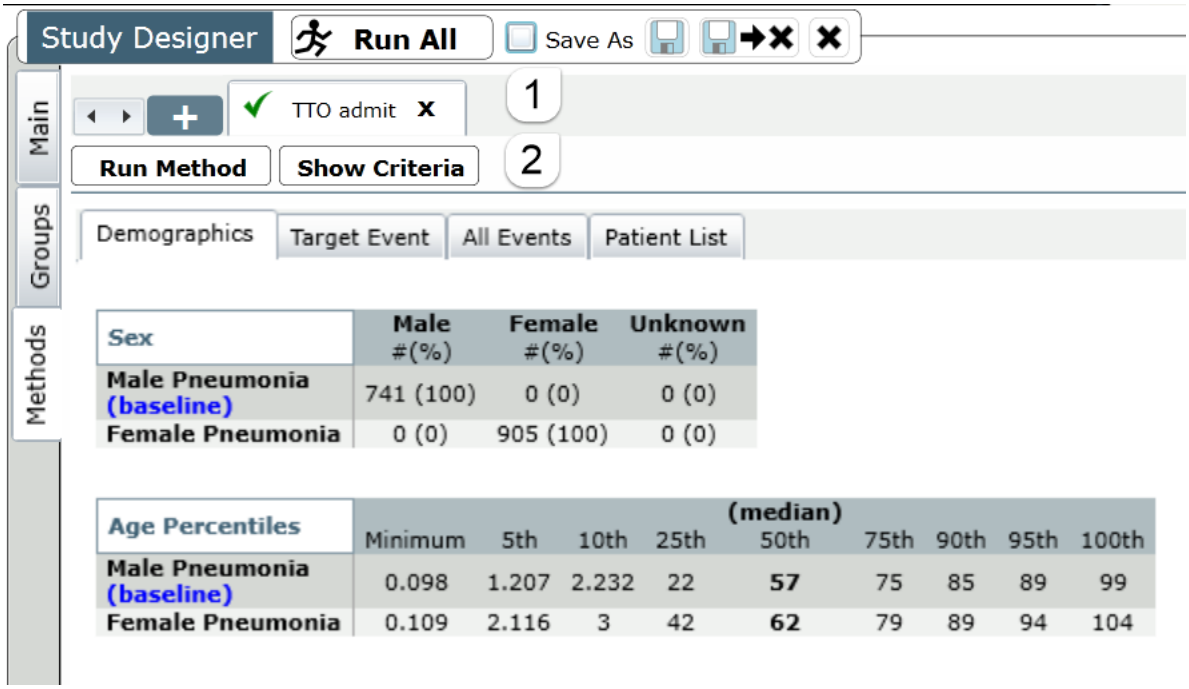
1- The Graph Name is renamed
2- Left click on Run Method
3- Left click on Save.

Note: In event canvas, a build automatically saved the rules and the cohort or event collection. I warned you not to manually save after an event canvas build as a user initiated save in event canvas saves only the rules and deletes the mrns.

BUT…….

The convention in study designer is the opposite. A run in study designer is not automatically saved. A save or Save and exit, saves the results and the rules and must be done after every run.

Now let's look at the results.

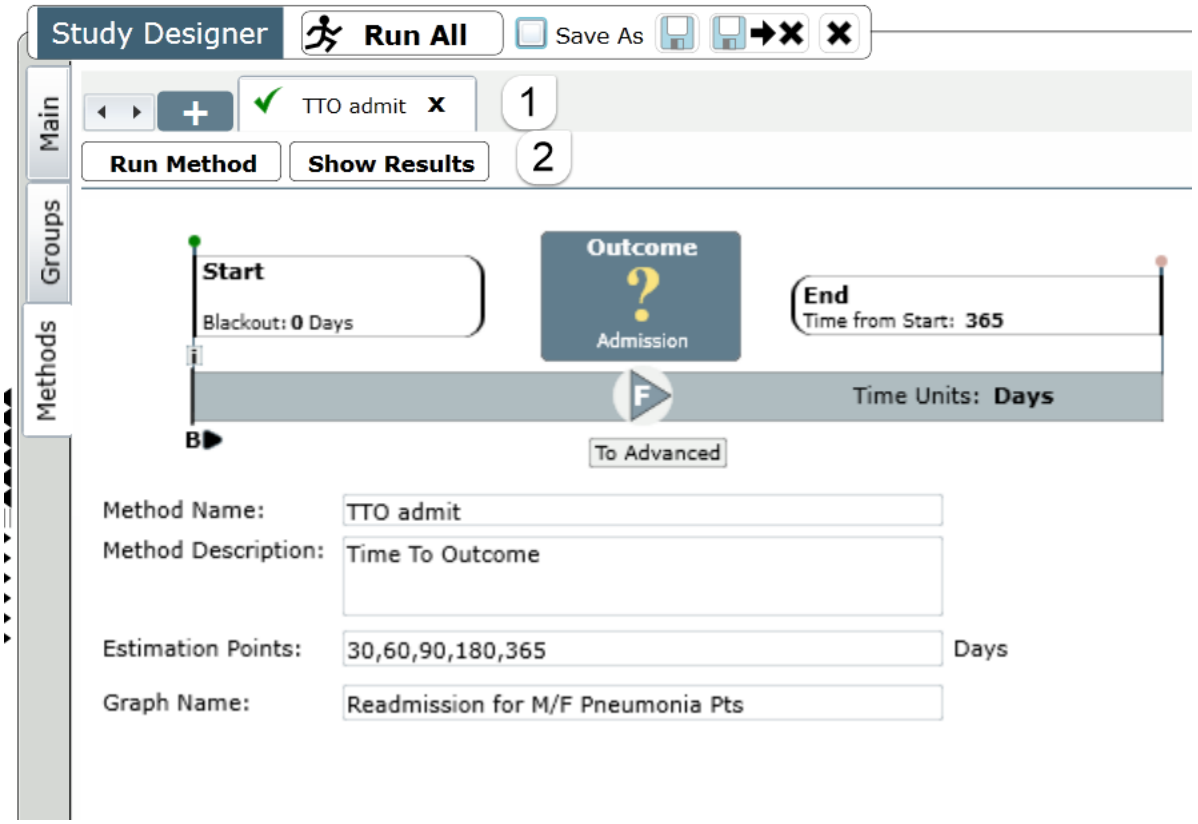


Sex	Male #(%)	Female #(%)	Unknown #(%)
Male Pneumonia (baseline)	741 (100)	0 (0)	0 (0)
Female Pneumonia	0 (0)	905 (100)	0 (0)

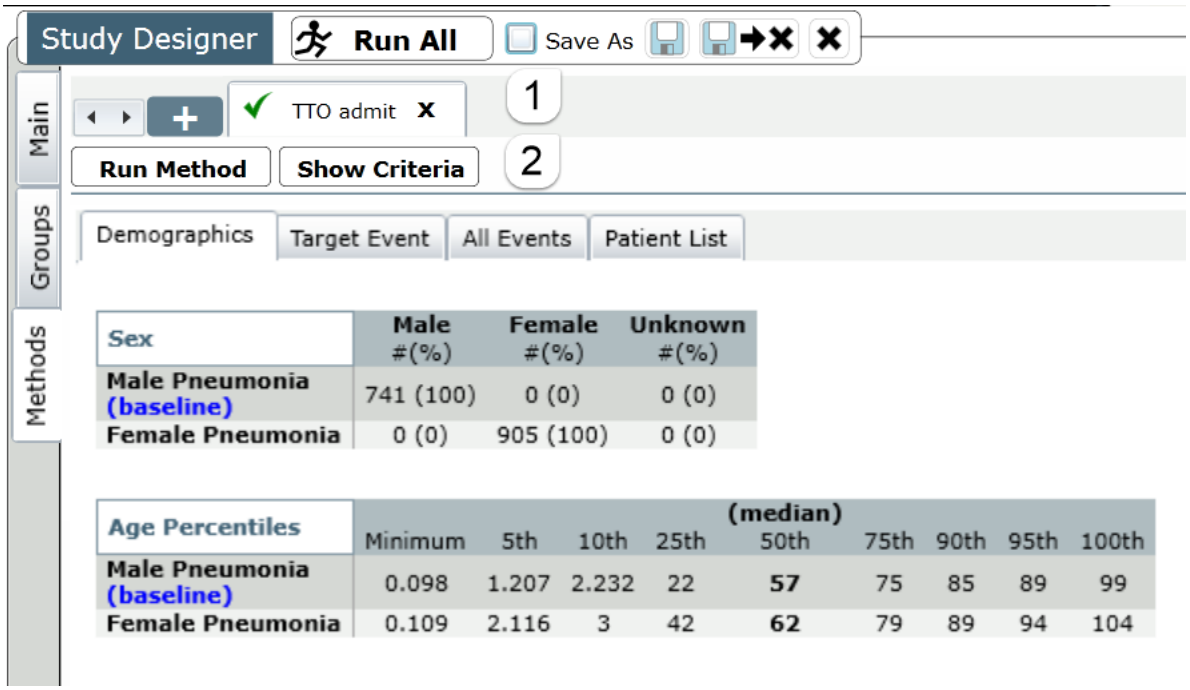
Age Percentiles	Minimum	5th	10th	25th	(median) 50th	75th	90th	95th	100th
Male Pneumonia (baseline)	0.098	1.207	2.232	22	**57**	75	85	89	99
Female Pneumonia	0.109	2.116	3	42	**62**	79	89	94	104

After the run, you continue to see the

1- TTO admit Method tab
2- And now next to the "Run Method Tab" is a "Show Criteria Tab". This is a toggle switch between "Show Criteria" and "Show Results"
Clicking on "Show Criteria" reveals:



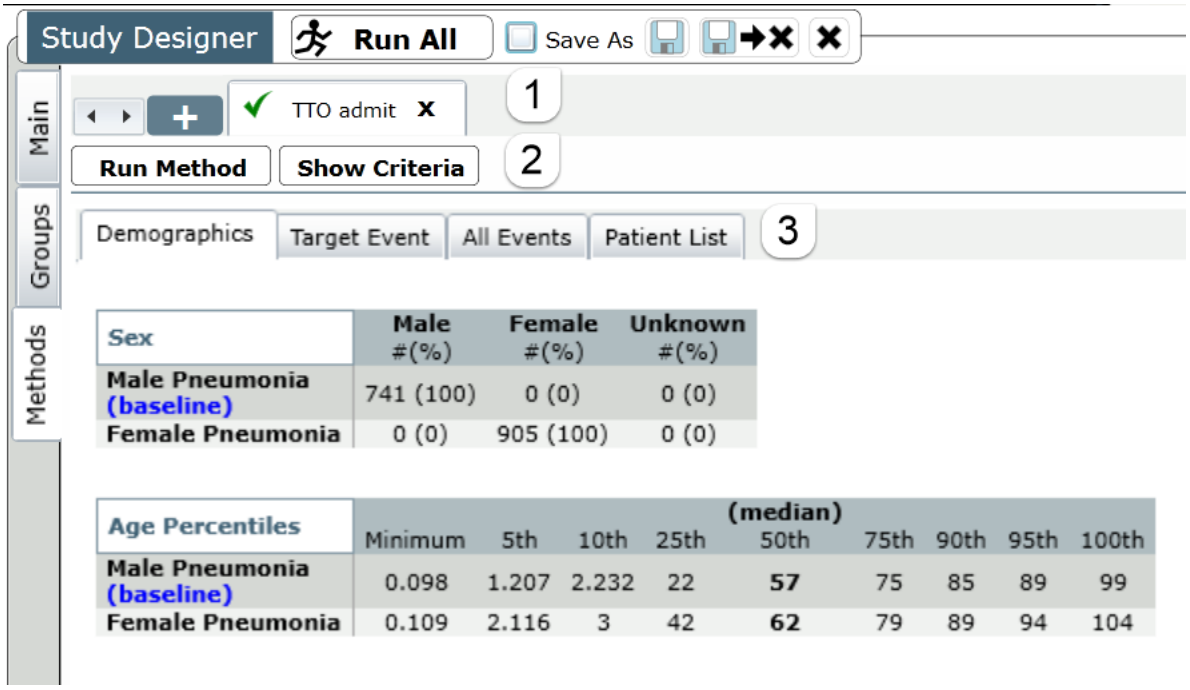
Click on “Show Results” to get the results again:



Sex	Male #(%)	Female #(%)	Unknown #(%)
Male Pneumonia (baseline)	741 (100)	0 (0)	0 (0)
Female Pneumonia	0 (0)	905 (100)	0 (0)

Age Percentiles	Minimum	5th	10th	25th	(median) 50th	75th	90th	95th	100th
Male Pneumonia (baseline)	0.098	1.207	2.232	22	**57**	75	85	89	99
Female Pneumonia	0.109	2.116	3	42	**62**	79	89	94	104

Now notice a third line that is new:



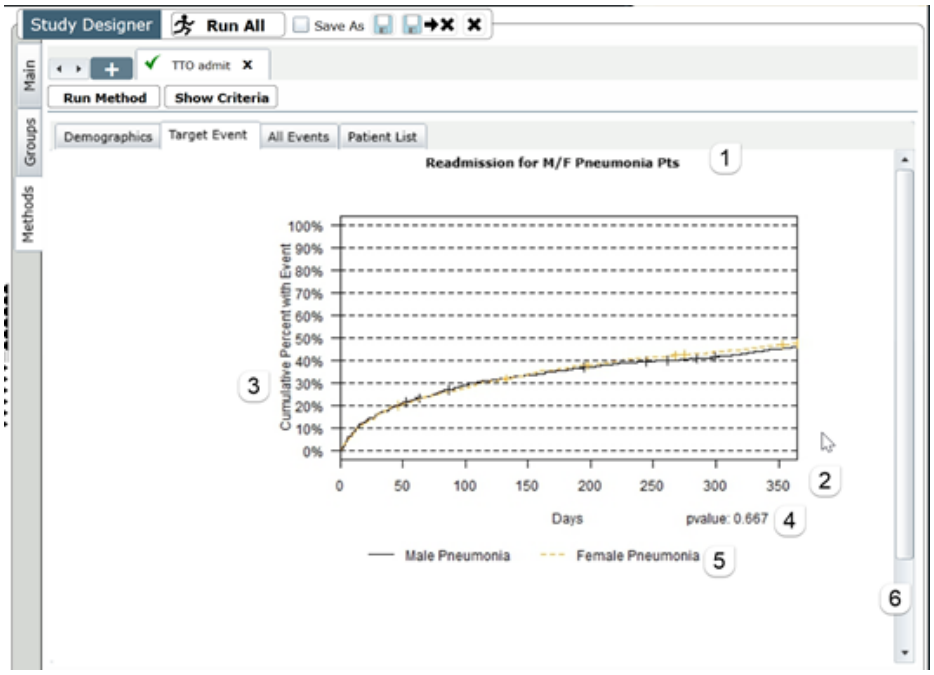
Sex	Male #(%)	Female #(%)	Unknown #(%)
Male Pneumonia (baseline)	741 (100)	0 (0)	0 (0)
Female Pneumonia	0 (0)	905 (100)	0 (0)

Age Percentiles	Minimum	5th	10th	25th	(median) 50th	75th	90th	95th	100th
Male Pneumonia (baseline)	0.098	1.207	2.232	22	**57**	75	85	89	99
Female Pneumonia	0.109	2.116	3	42	**62**	79	89	94	104

3- These are tabs within the "TTO admit" method canvas. These tabs represent canvases within the TTO admit Canvas. Each subcanvas conveniently provides outcomes relevant to the TTO admit method.

As you click on demographics, Target Event, All Events, Patient List sequentially, that tab becomes white and its associated sub-canvas is filled with the relevant results of that tab.

Demographics tab – provides the male / female breakdown and age percentiles.



The Target Event provides a graph that shows

1- the name you chose

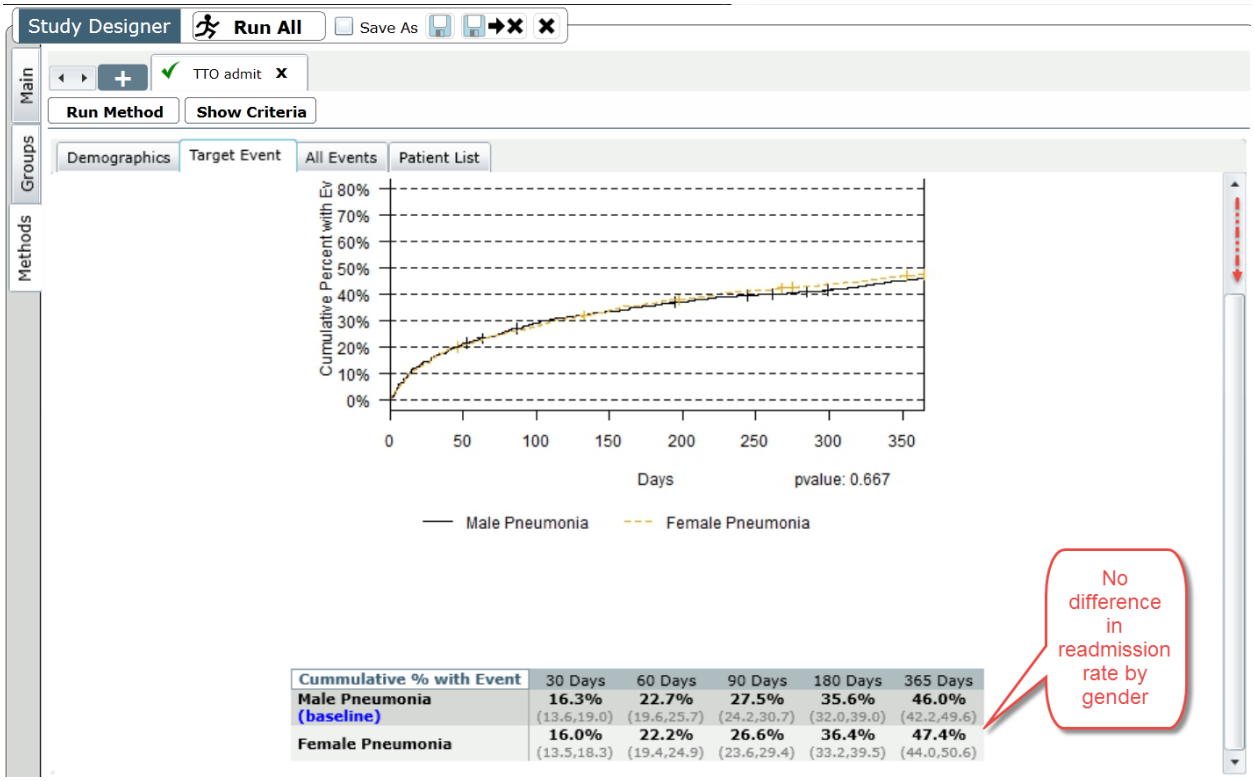
2- elapsed time from the index date

3- Y – axis cumulative incidence of at least one admission by the associated date on the x axis. Cumulative percent with at least one admission by that time

4- p value of the comparison (in this case not significant (significance being <.05)

5- the legend for the two populations

6- A vertical window slider bar so we can see the table below the graph

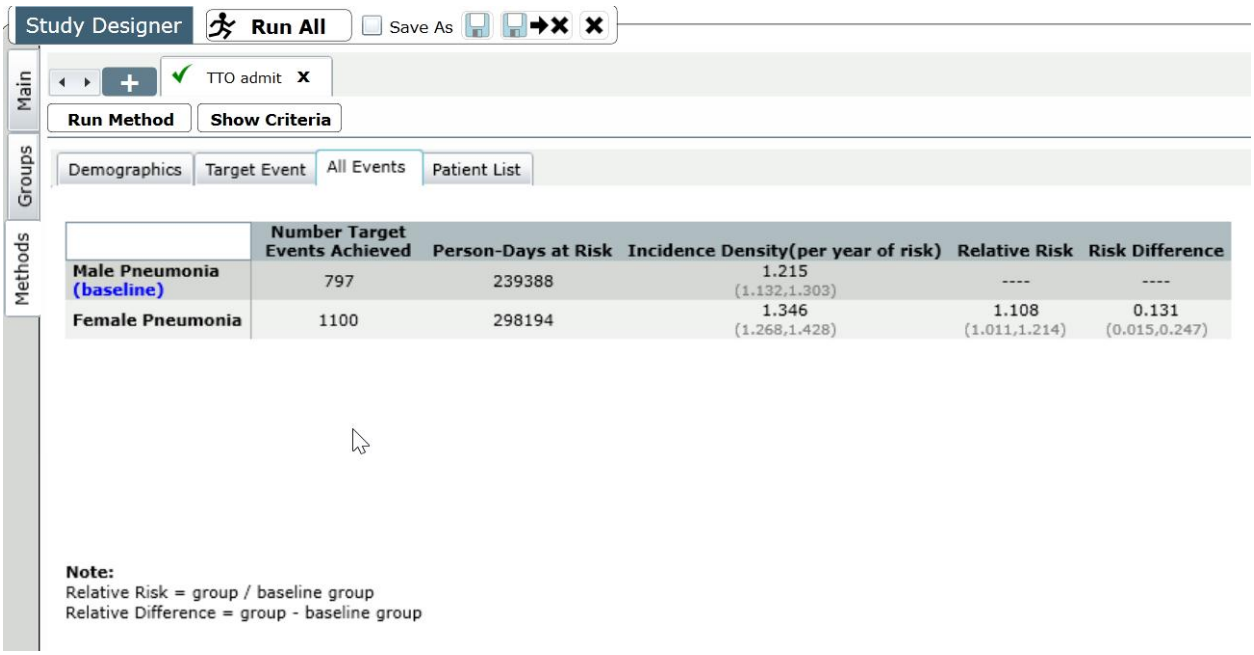


Cummulative % with Event	30 Days	60 Days	90 Days	180 Days	365 Days
Male Pneumonia (baseline)	16.3% (13.6,19.0)	22.7% (19.6,25.7)	27.5% (24.2,30.7)	35.6% (32.0,39.0)	46.0% (42.2,49.6)
Female Pneumonia	16.0% (13.5,18.3)	22.2% (19.4,24.9)	26.6% (23.6,29.4)	36.4% (33.2,39.5)	47.4% (44.0,50.6)

46% of male pneumonia patients are admitted at least once by 365 days, while 47.4% of Female pneumonia patients are readmitted at least once by 365 days. Under these numbers are parentheses that provide the 95% confidence interval for the observation.

You notice vertical lines in the graph. These are censorship lines. They are recorded every time an individual patient is censored. The individual can be censored by death or by run out of time. Since all the patients were seen in 2010, all of them had the ability to be seen for a year unless death censored them. Had the study involved patients admitted only two months ago then those patients would have been censored at month two and we would have seen a large number of vertical lines.

We now click on the All Events tab:



In this tab we count all the downstream admissions in the next 365 days not merely the first.

We also count the number of person-days of observation in each group. Unless a person is censored by either death or administrative run out of time, each patient will contribute 365 days of follow up time.

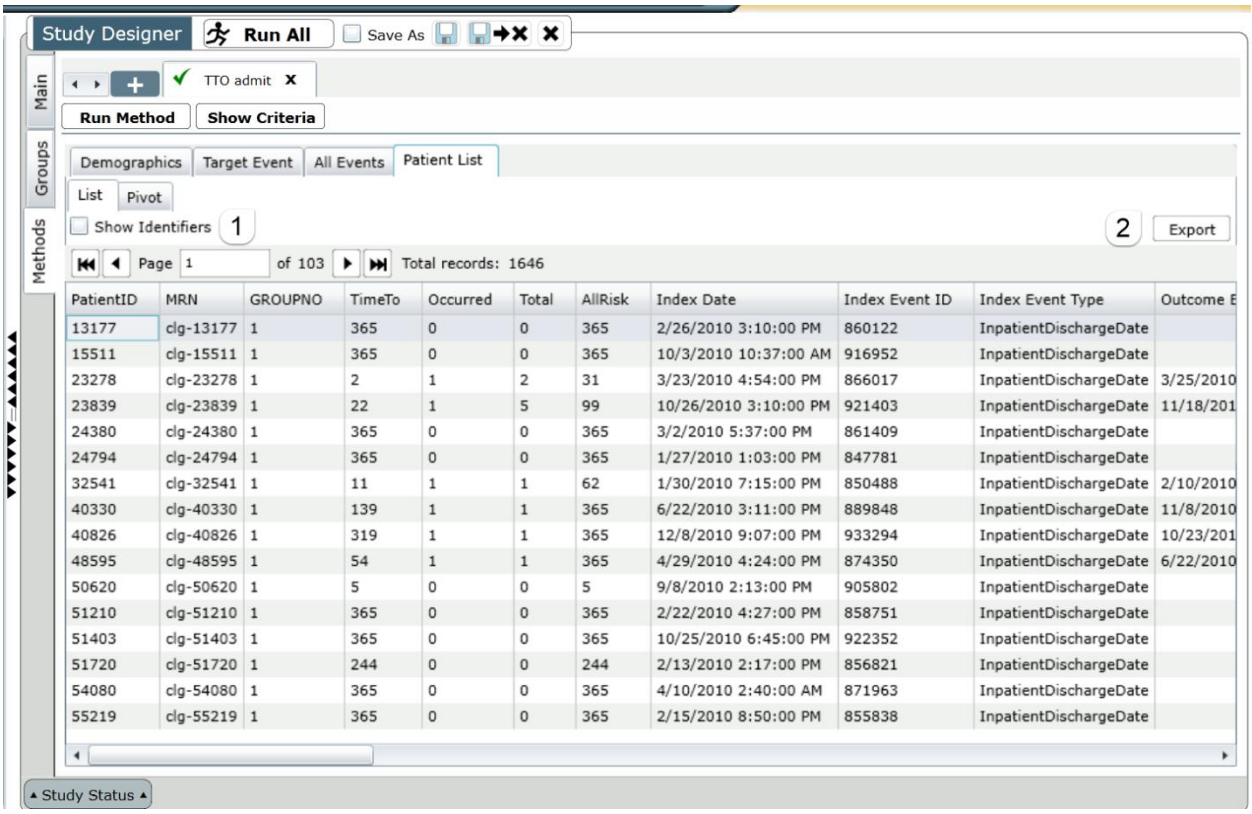
We then calculate the third column incidence density per year of risk. Of note, now Female pneumonia patients have a higher incidence density.

When we divide the Female by the Male incidence density we get a relative risk greater than 1 1.108 and a 95% confidence interval that excludes one which means the results are statistically significant. This suggests that when you consider all admissions not just the first, women have a higher readmission rate. If you forget what is being divided by what, look down the canvas and read the Note.

The last column is the risk difference model. Risk difference calculates the group risk – the baseline group risk. In our case this is the Female risk – male Risk. We see the difference is positive and zero is excluded so this is in fact significant. Women have a higher risk by the risk difference method when you count all admissions downstream not just the first.

Warning: Before you draw any conclusions, you might want to look at mortality rate downstream of the first readmission as the Dead do not get readmitted.

Left clicking on Patient List tab results in:



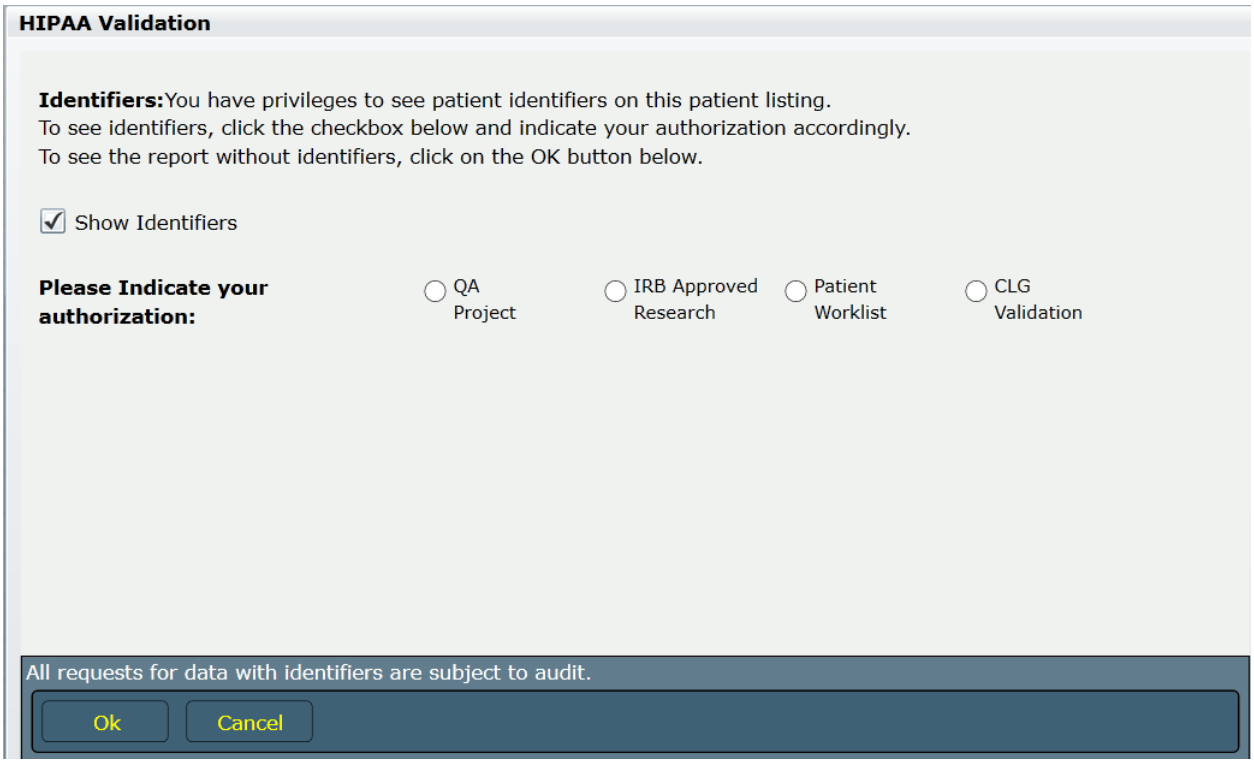
PatientID	MRN	GROUPNO	TimeTo	Occurred	Total	AllRisk	Index Date	Index Event ID	Index Event Type	Outcome E
13177	clg-13177	1	365	0	0	365	2/26/2010 3:10:00 PM	860122	InpatientDischargeDate	
15511	clg-15511	1	365	0	0	365	10/3/2010 10:37:00 AM	916952	InpatientDischargeDate	
23278	clg-23278	1	2	1	2	31	3/23/2010 4:54:00 PM	866017	InpatientDischargeDate	3/25/2010
23839	clg-23839	1	22	1	5	99	10/26/2010 3:10:00 PM	921403	InpatientDischargeDate	11/18/201
24380	clg-24380	1	365	0	0	365	3/2/2010 5:37:00 PM	861409	InpatientDischargeDate	
24794	clg-24794	1	365	0	0	365	1/27/2010 1:03:00 PM	847781	InpatientDischargeDate	
32541	clg-32541	1	11	1	1	62	1/30/2010 7:15:00 PM	850488	InpatientDischargeDate	2/10/2010
40330	clg-40330	1	139	1	1	365	6/22/2010 3:11:00 PM	889848	InpatientDischargeDate	11/8/2010
40826	clg-40826	1	319	1	1	365	12/8/2010 9:07:00 PM	933294	InpatientDischargeDate	10/23/201
48595	clg-48595	1	54	1	1	365	4/29/2010 4:24:00 PM	874350	InpatientDischargeDate	6/22/2010
50620	clg-50620	1	5	0	0	5	9/8/2010 2:13:00 PM	905802	InpatientDischargeDate	
51210	clg-51210	1	365	0	0	365	2/22/2010 4:27:00 PM	858751	InpatientDischargeDate	
51403	clg-51403	1	365	0	0	365	10/25/2010 6:45:00 PM	922352	InpatientDischargeDate	
51720	clg-51720	1	244	0	0	244	2/13/2010 2:17:00 PM	856821	InpatientDischargeDate	
54080	clg-54080	1	365	0	0	365	4/10/2010 2:40:00 AM	871963	InpatientDischargeDate	
55219	clg-55219	1	365	0	0	365	2/15/2010 8:50:00 PM	855838	InpatientDischargeDate	

A restricted data set. This is not considered anonymized because it has dates of service. Limited data sets under Hipaa must be treated with respect and encrypted if not onsite in a monte machine.

1- clicking on show identifiers will result in a Hipaa challenge demanding that you justify your request to view identifiers.

2- exports data in either excel or csv format

The Hipaa challenge looks like this:


HIPAA Validation
Identifiers:You have privileges to see patient identifiers on this patient listing.
To see identifiers, click the checkbox below and indicate your authorization accordingly.
To see the report without identifiers, click on the OK button below.
Show Identifiers
Please Indicate your authorization:
QA Project
IRB Approved Research
Patient Worklist
CLG Validation
All requests for data with identifiers are subject to audit.
Ok
Cancel

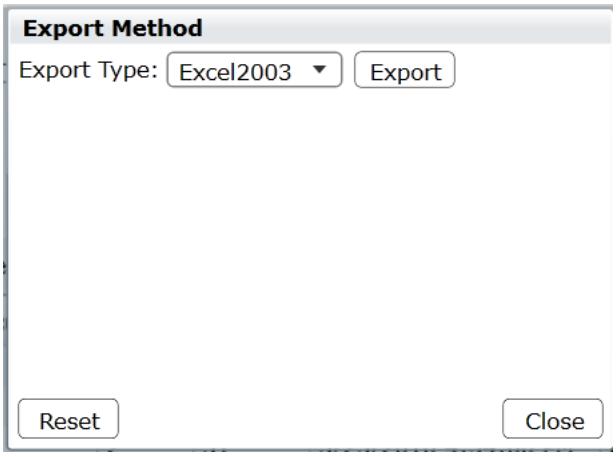
QA project – you have registered your project with the QI department

IRB research – enter the IRB number that permits you to view identifiers

Patient Worklist – you are actively using these lists now to deliver clinical care to patients for whom you have a physician-patient relationship. Example: Creating a list of patients who have not received the influenza vaccine so you can call them in for vaccination.

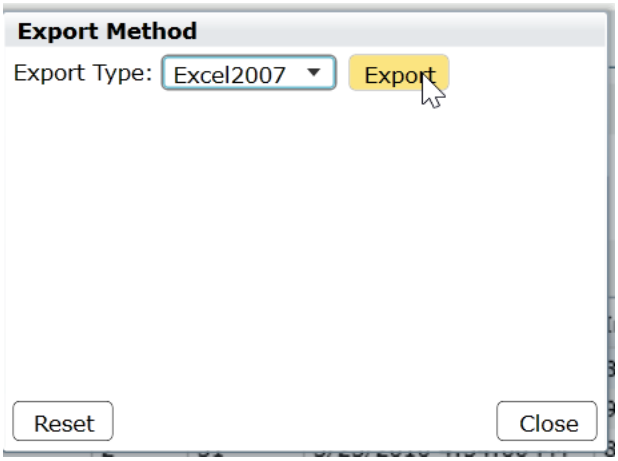
CLG validation – (rarely invoked) you are working with the CLG maintenance team to help determine the nature of a bug in the program.

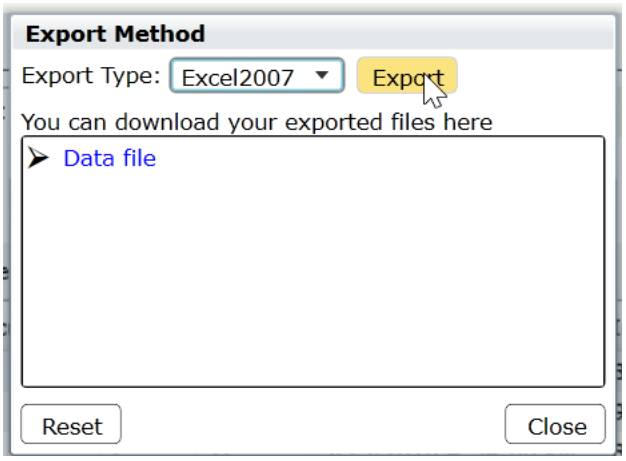
When you left click export the following appears:



When you left click on the downward arrow, a drop down menu appears.

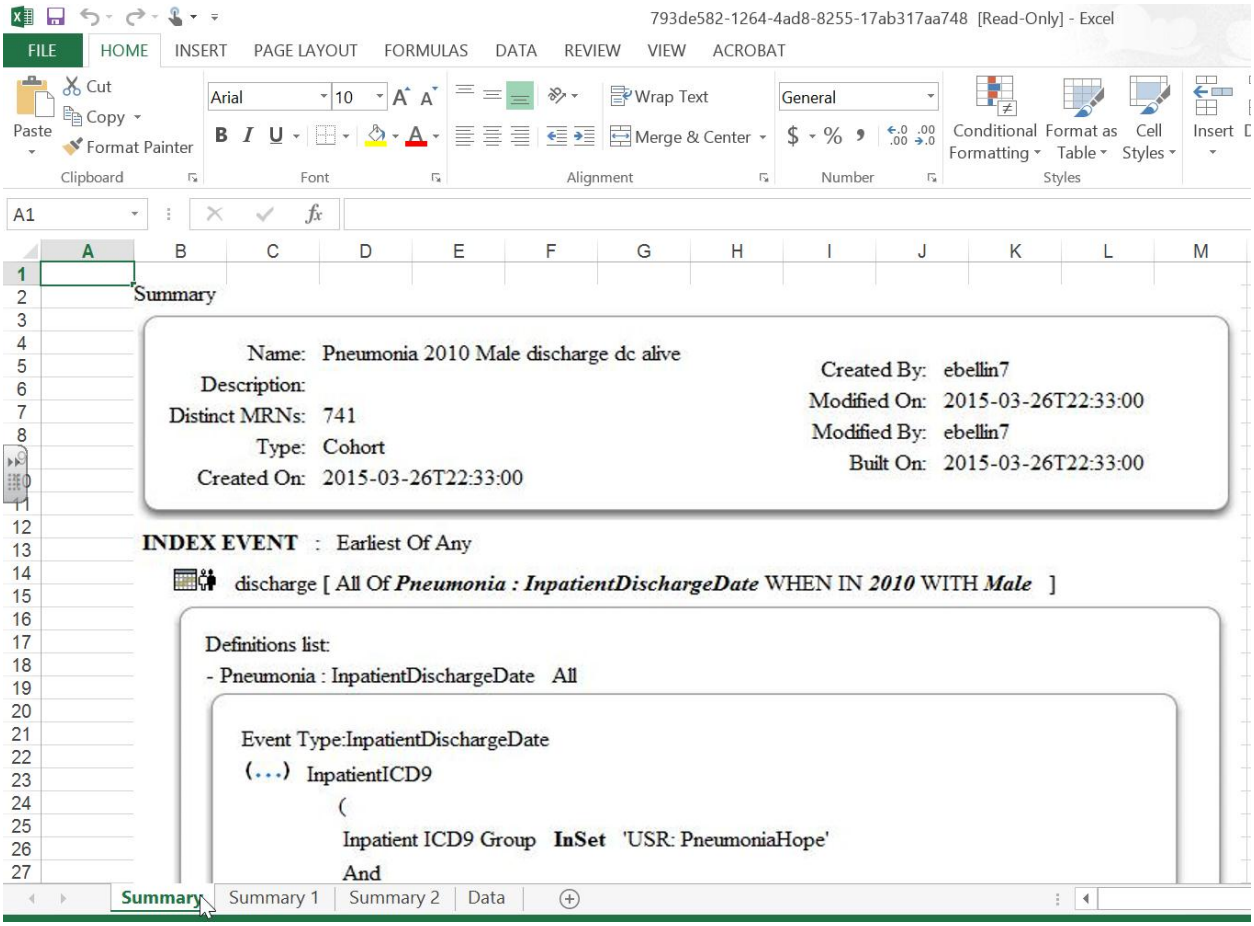
Choose excel 2007 as excel 2003 is limited to 65,000 rows and a smaller number of columns:





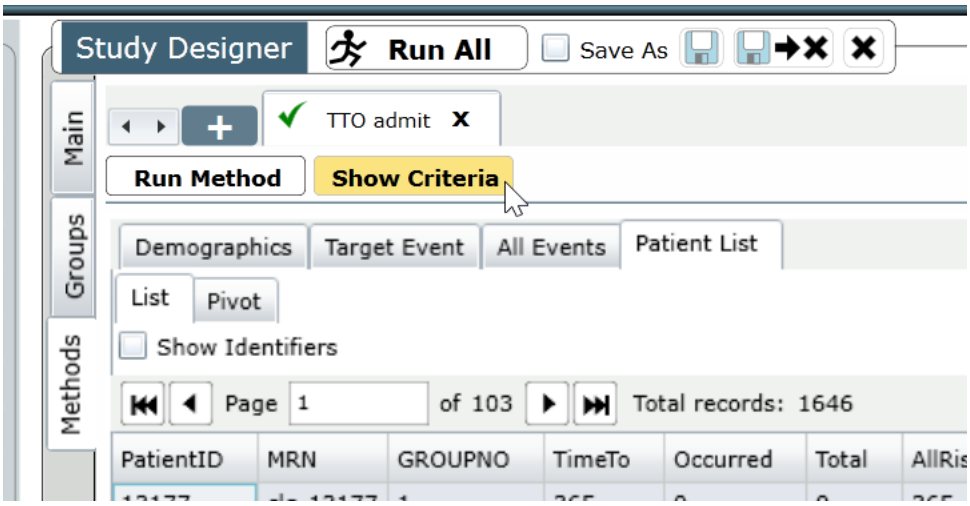
Left click export and a “data file” appears.

Left click on the data file and the spreadsheet opens.

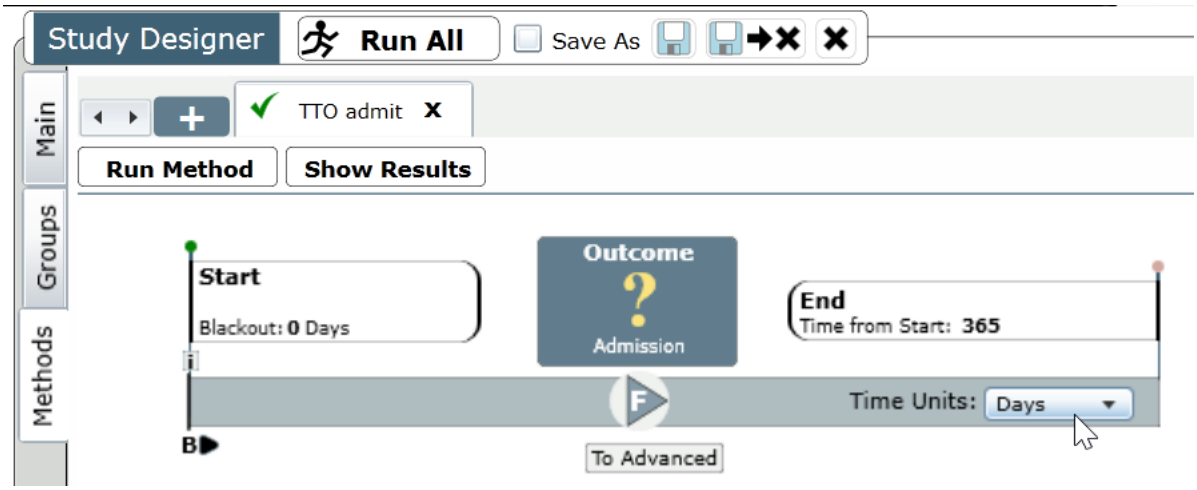


The first two summary tabs provide the criteria for the two cohorts. The third summary tab named “Summary 2” provides the criteria for the outcomes and the last data tab provides the information of the TTO object. Including Occurred – whether the event happened =1, or was censored =0. Allrisk is the amount of time the patient was under observation without censorship. For greater detail go to the CLG user manual.

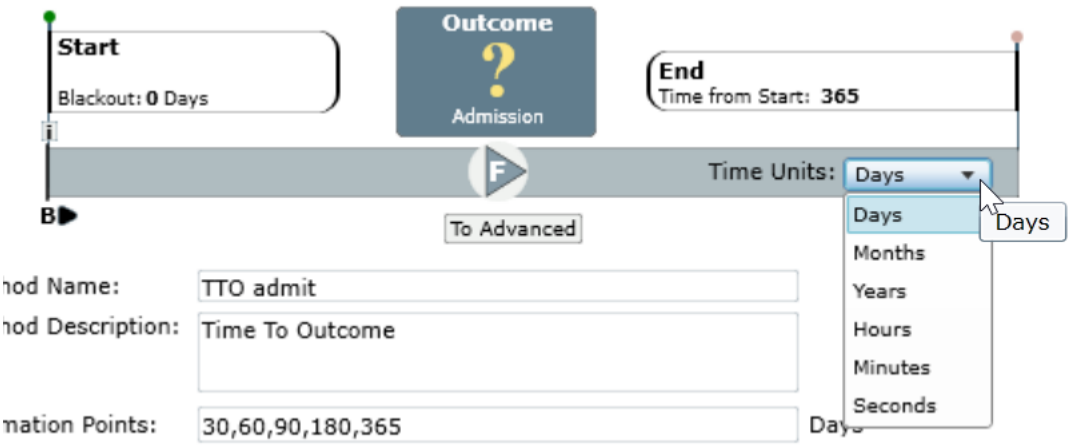
Before we leave this example let’s return to the criteria:



You have the ability to change the units of time:



By hovering over the Days, the area is activated, a downward arrow appears, and a left click on this arrow will show you the options you have for units of time.



As a rule of thumb, if the interval 0 to 1, is important to you, you should choose a unit of time measure smaller than the unit you are interested in.

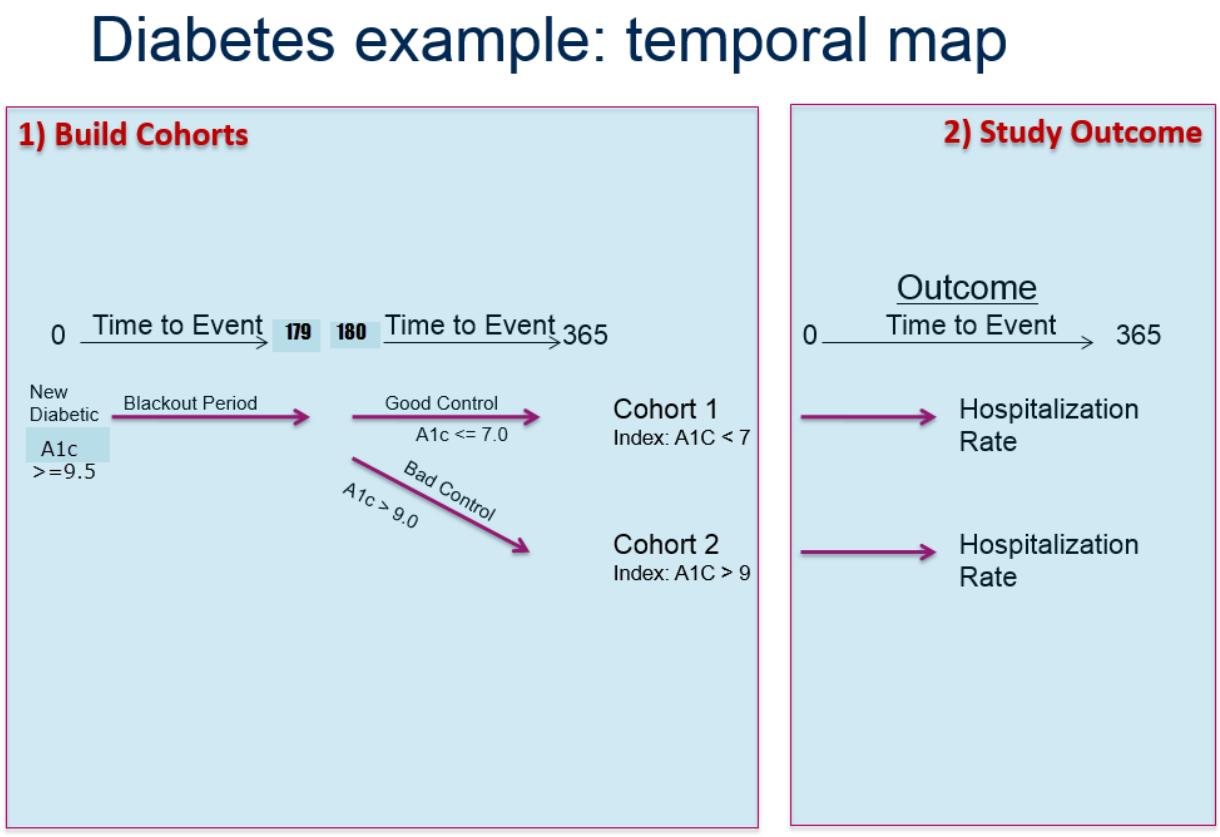
Challenge Problem #1

Tutorial 15: Challenge Problem - Hospitalization rate post attempt at Diabetes Control
https://www.youtube.com/watch?v=GprwqUZsQ_4&list=PLf7raPnmlLOeAWU2cNf2jIMDRqQuUTCum&index=15

Using Cohorts you have built and the new skills you have learned solve the following Problem.

You want to know whether Diabetic Patients who initially have horrible HgbA1c (greater than or equal to 9.5) who within 180 days to a year are brought under good control (repeat HgbA1c less than or equal to 7), have a higher or lower hospital admission rate after control, compared with Patients with a horrible HgbA1c whose HgbA1c on repeat study six months to a year later are greater than or equal to 9.

First, build a mental map of the question:

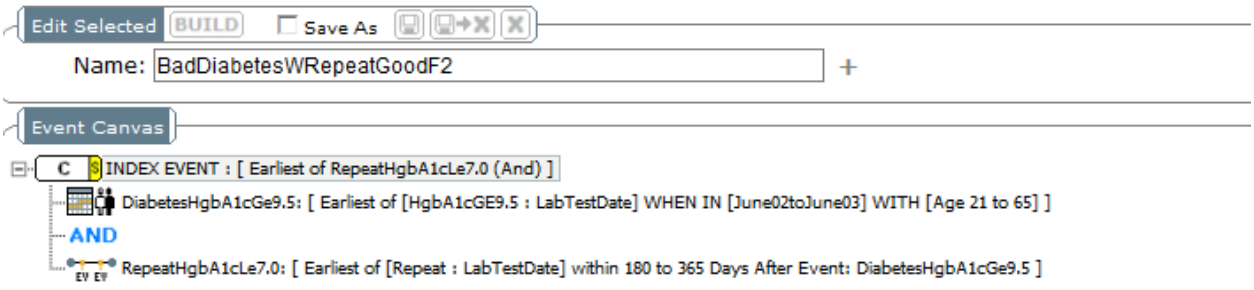


The cohorts should look very familiar. You built them before. BadDiabetesWRepeatGoodF2 and BadDiabetesWRepeatBadF2.

We will therefore use these cohorts in a new Time to Outcome study. We will choose these two groups and evaluate elapsed time until first admission.

WARNING!!!!

You need to think carefully about your study design. You are undertaking a time to outcome study. You are collecting elapsed time from some event to some outcome. Which event condition line in the cohort are you referencing?


Edit Selected
BUILD
Save As
Name: BadDiabetesWRepeatGoodF2
Event Canvas
C
INDEX EVENT : [Earliest of RepeatHgbA1cLe7.0 (And)]
DiabetesHgbA1cGe9.5: [Earliest of [HgbA1cGE9.5 : LabTestDate] WHEN IN [June02toJune03] WITH [Age 21 to 65]]
AND
RepeatHgbA1cLe7.0: [Earliest of [Repeat : LabTestDate] within 180 to 365 Days After Event: DiabetesHgbA1cGe9.5]

You have two condition lines

1- Diabetic patients (HgbA1c GE 9.5)

2- Repeat HgbA1c LE 7.0

Your **Index Event Line** determines which of these two condition lines generates the Index Date.

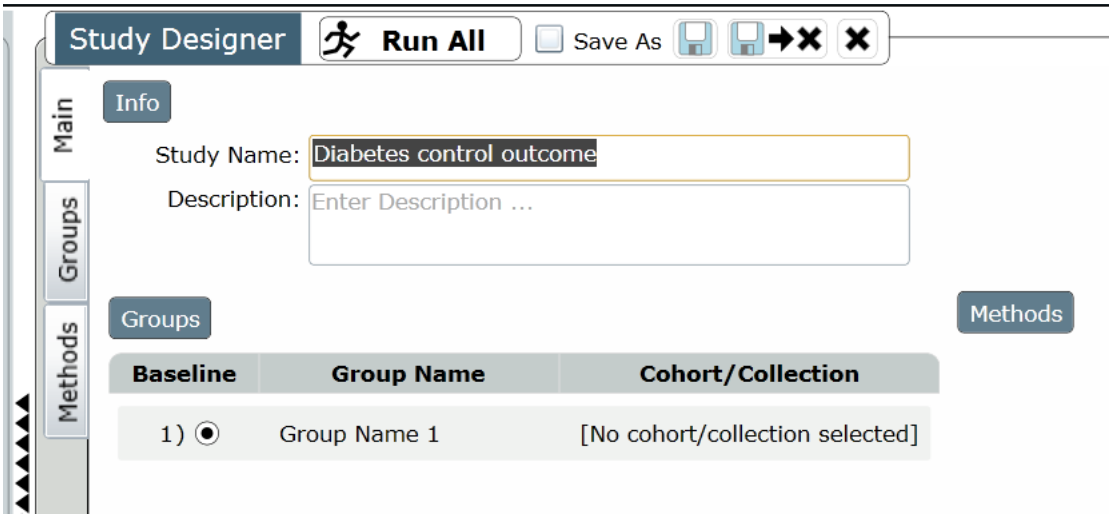
Since our question is asking how much time elapses from the achievement of good or bad HgbA1c, our question is asking about elapsed time from the second condition line (repeat HgbA1cLE7.0).

You must make sure your index event line is pointing to the second condition line, i.e. the second event.

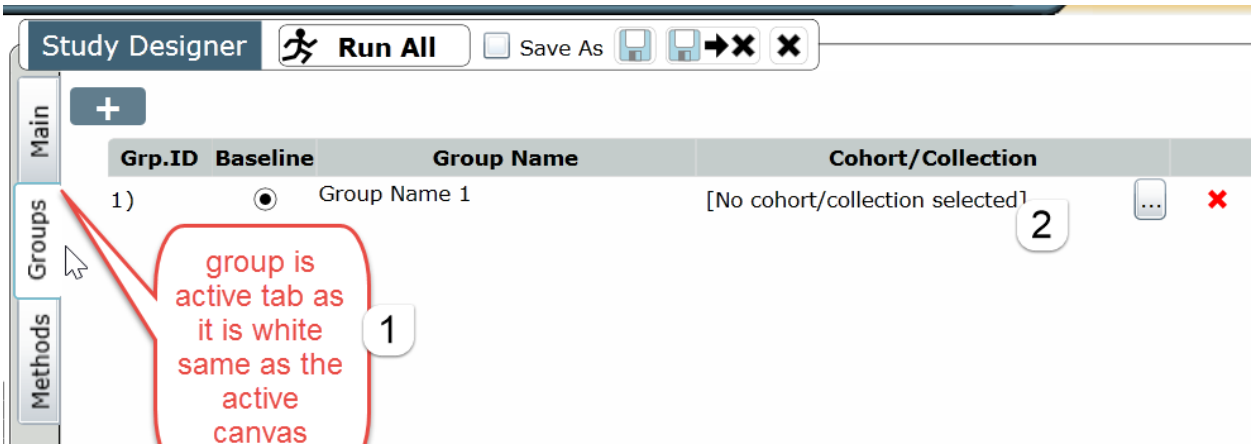
Make sure that both your cohorts are pointing to the second event.

Here are the steps.

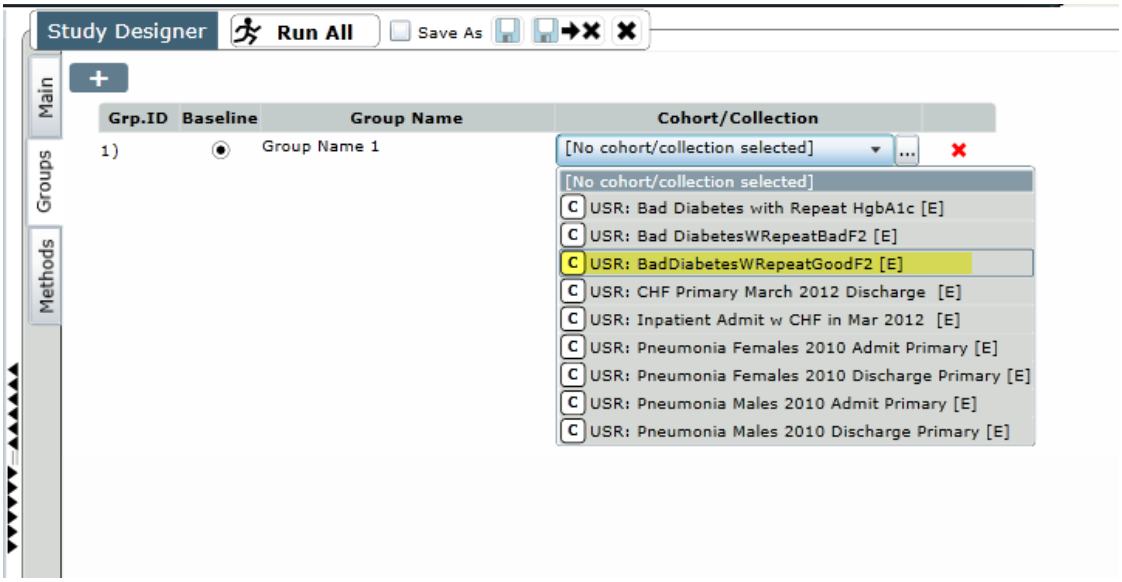
1. In “Main tab” Name the study “Diabetes Control Outcome”



2. Activate Group tab

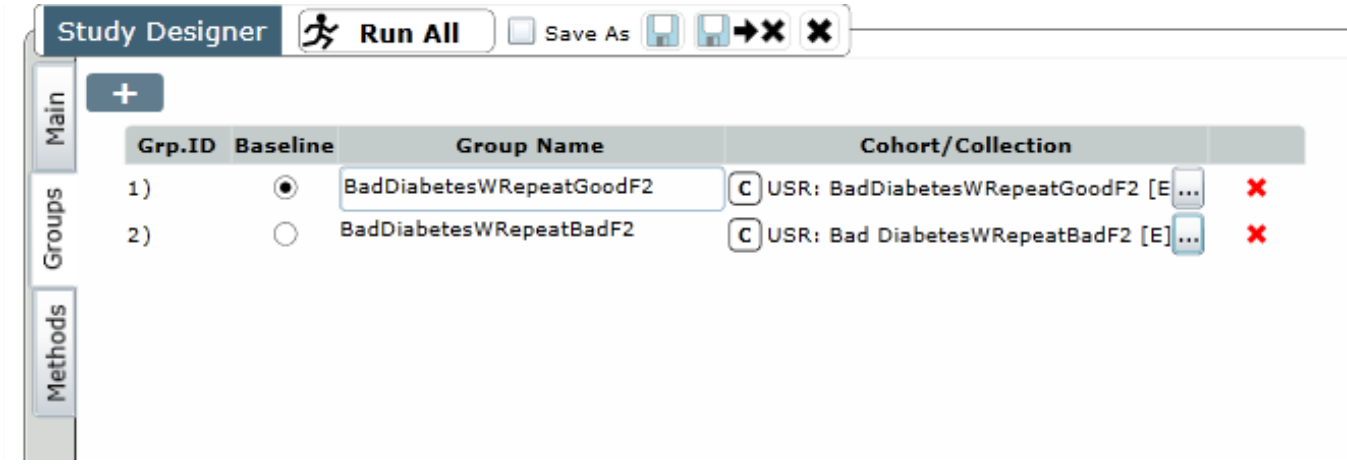


3. 2- left click on downward arrow next to [No cohort /collection selected] and choose the “BadDiabetesWRepeatGoodF2” as first group. Note, the good controlled group is the baseline.

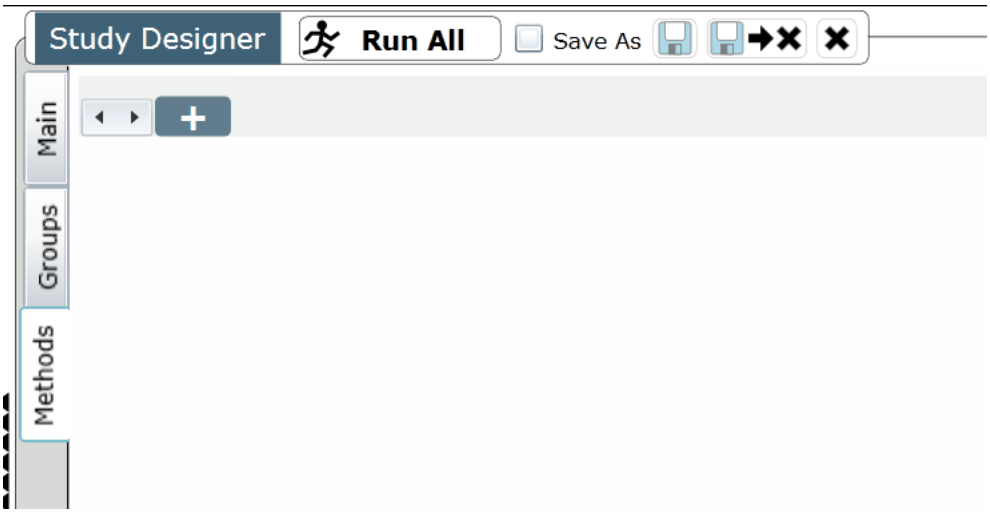


4. Name the group “BadDiabetesWRepeatGoodF2”
5. add another group
6. Name it “BadDiabetesWRepeatBadF2”.

Your Study Designer Canvas should look like this:

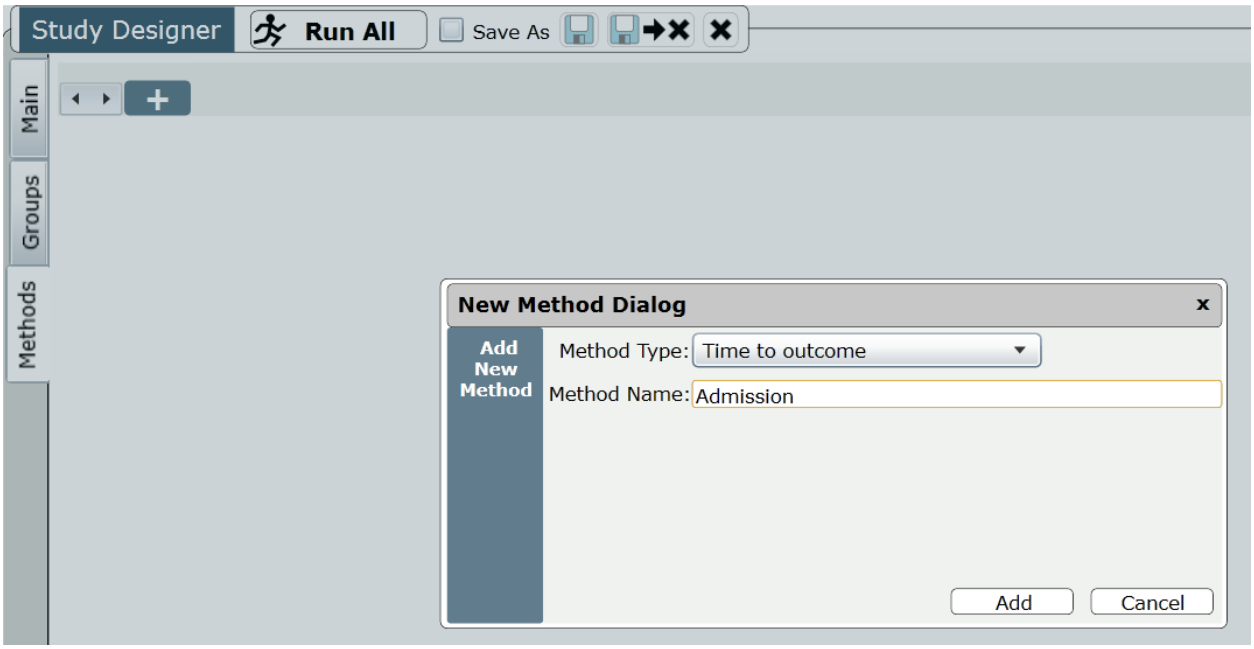


7. Left click on the Method tab to get you to the Method Canvas.

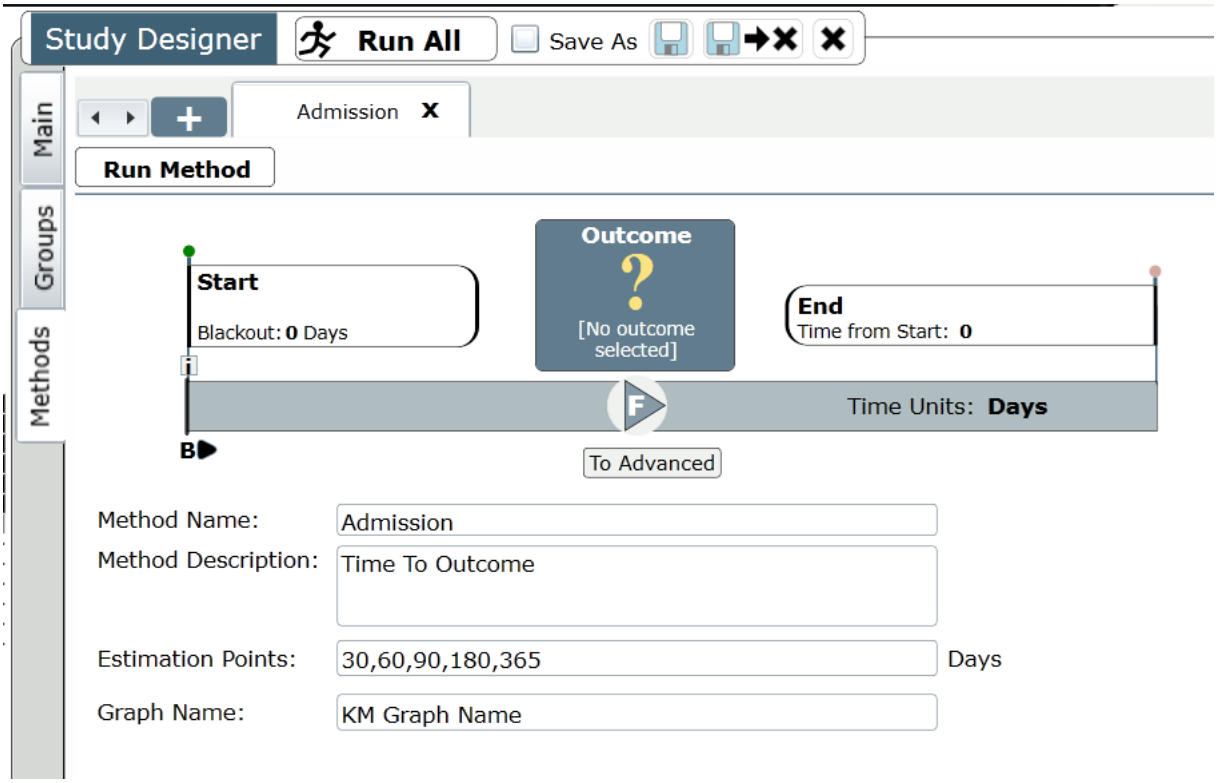


8. Left click on plus sign to Add a method
9. Choose Time to Outcome as your method
10. Name the method “Admission”

Resulting in:

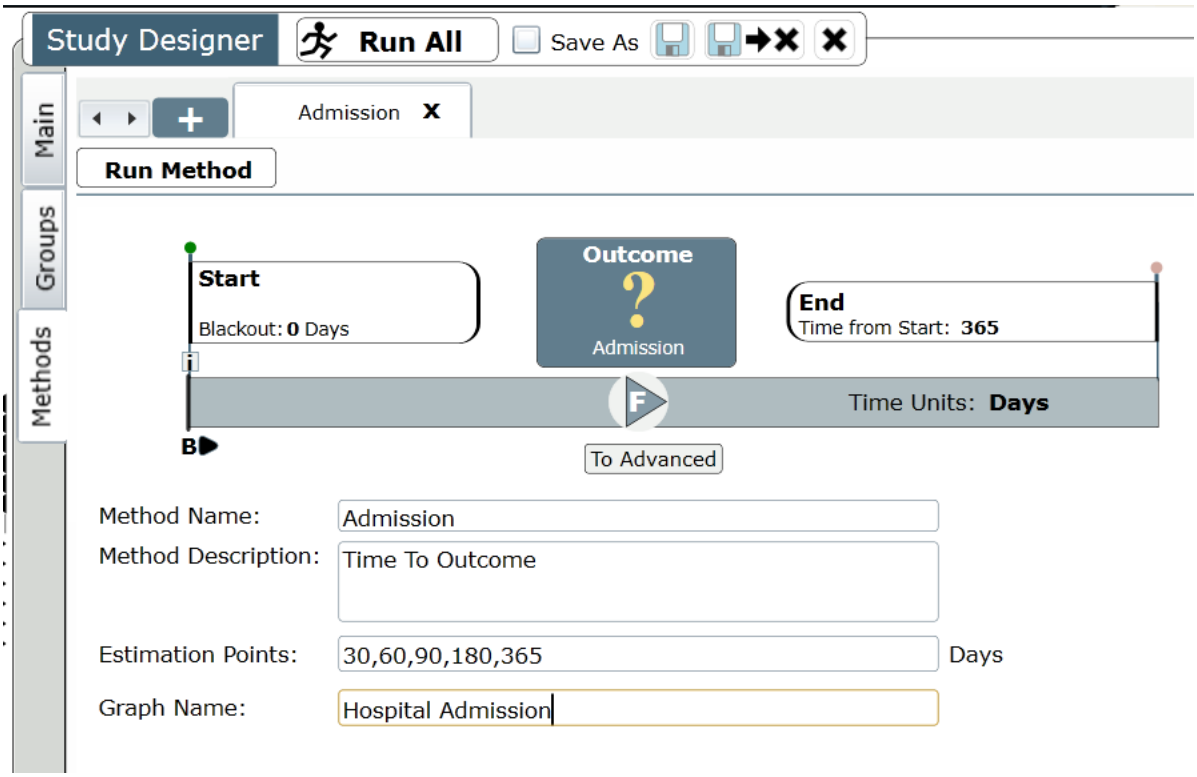


11. Left click on Add

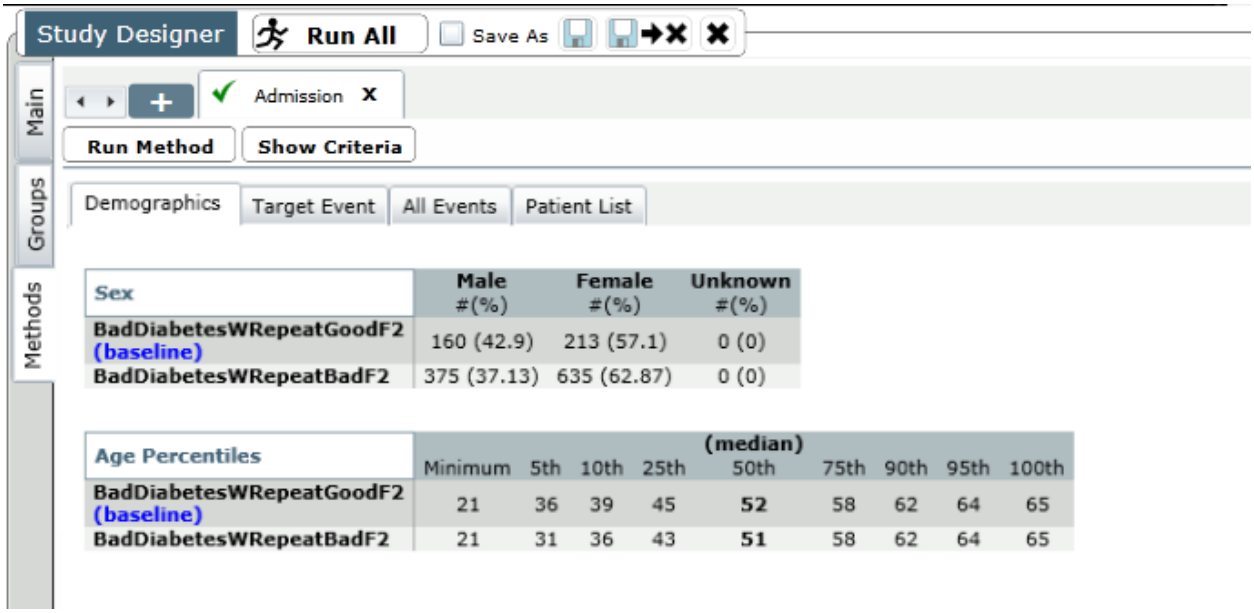


12. Now fill in the "Racetrack Metaphor" in the simple mode.
    a. Open the end flag and put in 365 days. Close End flag.
    b. Open the outcome box
    c. Choose from drop down "admission". You built this in your previous Pneumonia example.
    d. Close outcome box.
    e. Keep Method Name as is
    f. Keep Estimation Points: as is
    g. Change the Graph Name to Hospital Admission

    Your Study "Designer -Method Canvas" should look like this:

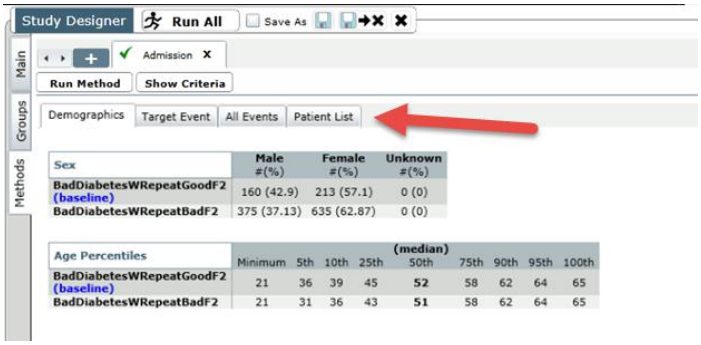


13. Run Method

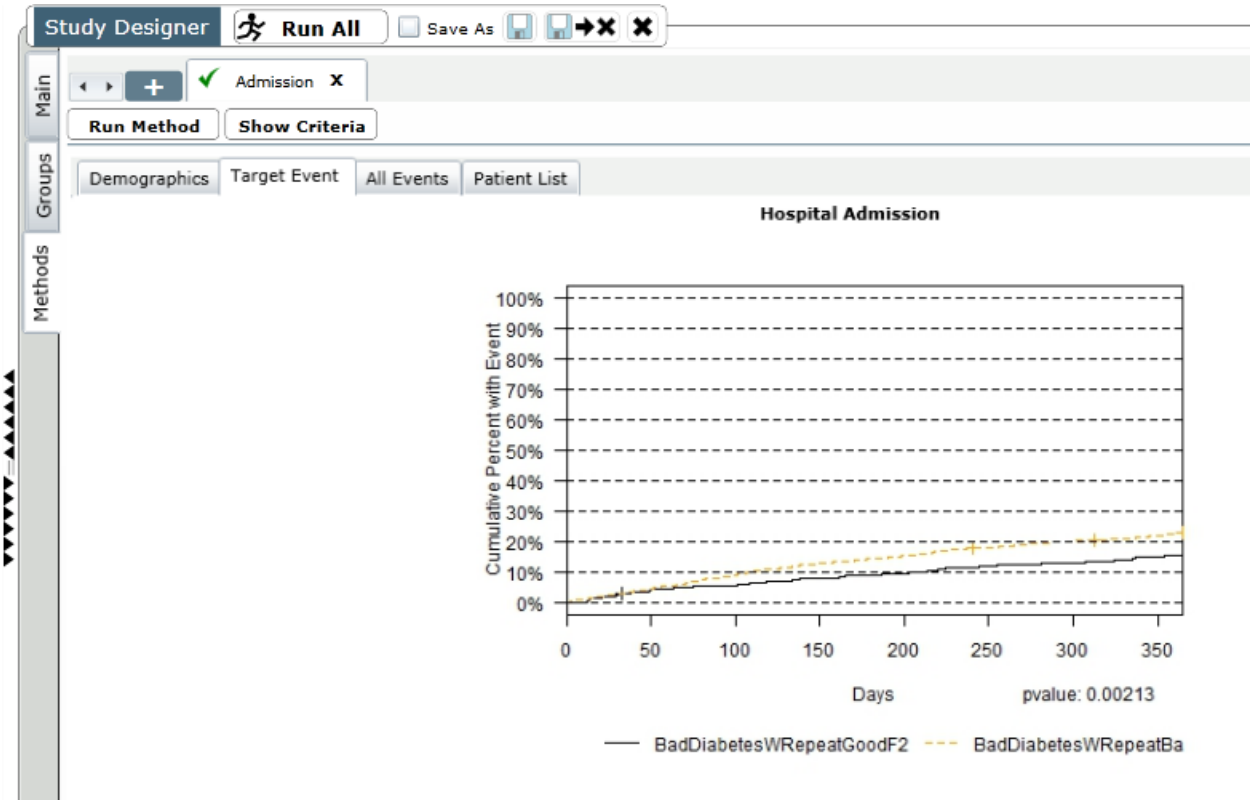


14. Save the study

15. Explore the resulting tabs Demographics, TargetEvent, All Events, Patient List



16. Choose the Target Event tab.



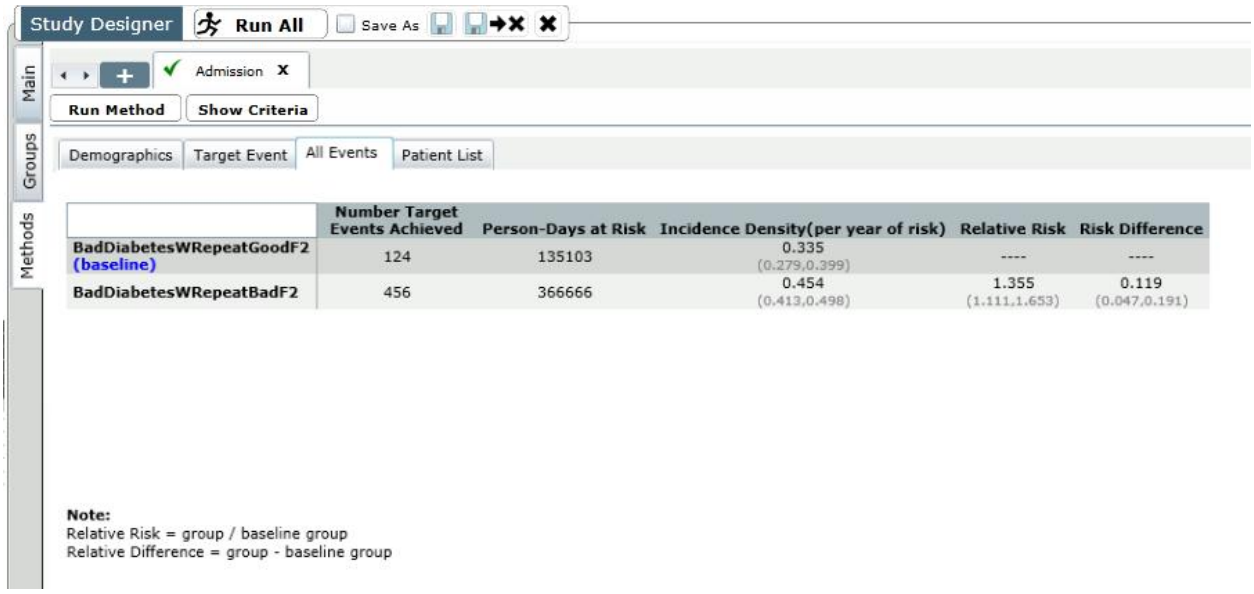
Cummulative % with Event	30 Days	60 Days	90 Days	180 Days	365 Days
BadDiabetesWRepeatGoodF2 (baseline)	2.7% (1.0,4.3)	4.6% (2.4,6.7)	5.4% (3.1,7.6)	9.1% (6.2,12.0)	15.3% (11.6,18.9)
BadDiabetesWRepeatBadF2	2.9% (1.8,3.9)	5.7% (4.3,7.2)	8.5% (6.8,10.2)	14.3% (12.1,16.4)	23.0% (20.4,25.6)

Figure 1 Elapsed Time to readmission from moment of Good (LE 7) or Bad (GE 9) Control

We note the Diabetic patients with a bad repeat HgbA1c test are climbing into the hospital faster than the Diabetic patients who had a good repeat HgbA1c. The cumulative incidence of first admissions for Diabetics with a bad repeat test at 365 days is 23% while for Diabetics with a good repeat test it is 15.3%. The p value is .002 and thus highly significant.

The 95% confidence interval of the two estimates at 365 days -(the parentheses under the estimates in the table) do not overlap – another indication of significance.

Left Click on the *All Events tab*



The ***All Events*** **Tab in the Simple mode** counts **all** the admissions (first, second, third…. after the index date.

By contrast, the **Target Event tab graph** counts only the **first admission** to calculate the Cumulative percent of patients admitted **at least once** by time on the x-axis.

The All events tab provides the relative risk of hospital admission considering all the admissions not just the first.

Conclusion: Diabetics with a bad repeat test are 1.355 times more likely to be admitted than Diabetics with a good repeat test.

Tutorial 16: Importance of Cohort Index Date on the meaning of a Study

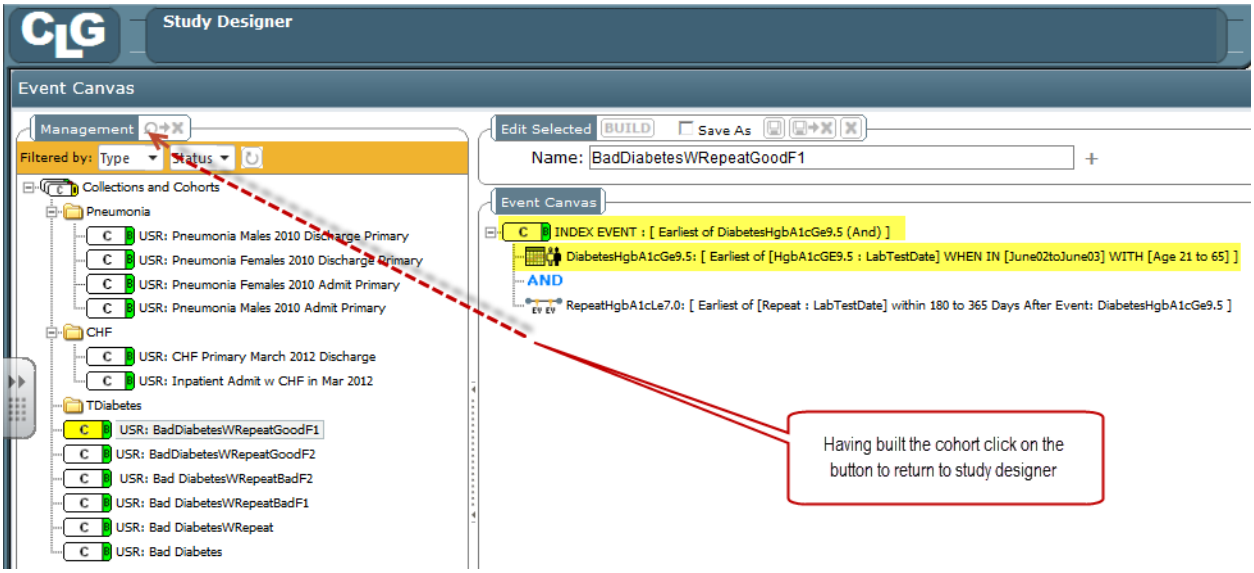
Tutorial 16: Importance of Cohort Index Date on the Meaning of a study (ppt6)
https://www.youtube.com/watch?v=ovRRrYUj_vA

Objectives:

a. Understand the impact of changing the Cohort Index Date on the nature of the question in study designer
b. Understand how to use the triple button in study designer to open event canvas and build new cohorts.

We are going to repeat the previous study but switch the index Event line from the second condition line to the first condition line.

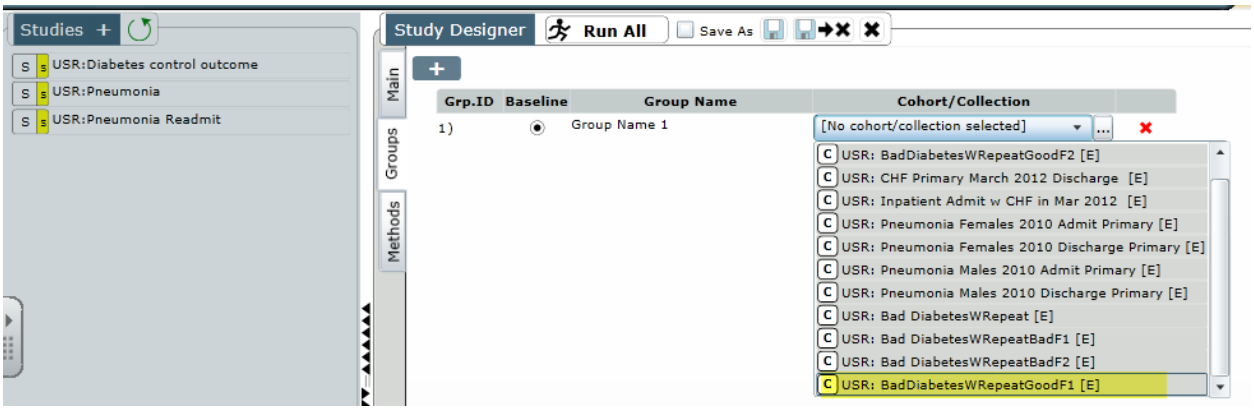
If you had not already built the necessary cohort, you could use the triple button to open event canvas and built a new cohort.


Study Designer
Event Canvas
Management
Filtered by: Type Status
Collections and Cohorts
Pneumonia
USR: Pneumonia Males 2010 Discharge Primary
USR: Pneumonia Females 2010 Discharge Primary
USR: Pneumonia Females 2010 Admit Primary
USR: Pneumonia Males 2010 Admit Primary
CHF
USR: CHF Primary March 2012 Discharge
USR: Inpatient Admit w CHF in Mar 2012
TDiabetes
USR: BadDiabetesWRepeatGoodF1
USR: BadDiabetesWRepeatGoodF2
USR: Bad DiabetesWRepeatBadF2
USR: Bad DiabetesWRepeatBadF1
USR: Bad DiabetesWRepeat
USR: Bad Diabetes
Edit Selected
BUILD
Save As
Name: BadDiabetesWRepeatGoodF1
Event Canvas
INDEX EVENT : [Earliest of DiabetesHgbA1cGe9.5 (And)]
DiabetesHgbA1cGe9.5: [Earliest of [HgbA1cGE9.5 : LabTestDate] WHEN IN [June02toJune03] WITH [Age 21 to 65]]
AND
RepeatHgbA1cLe7.0: [Earliest of [Repeat : LabTestDate] within 180 to 365 Days After Event: DiabetesHgbA1cGe9.5]
Having built the cohort click on the button to return to study designer

Once having built the cohort, you could then left click on the management pane of the event canvas and find yourself back on the Study designer canvas.

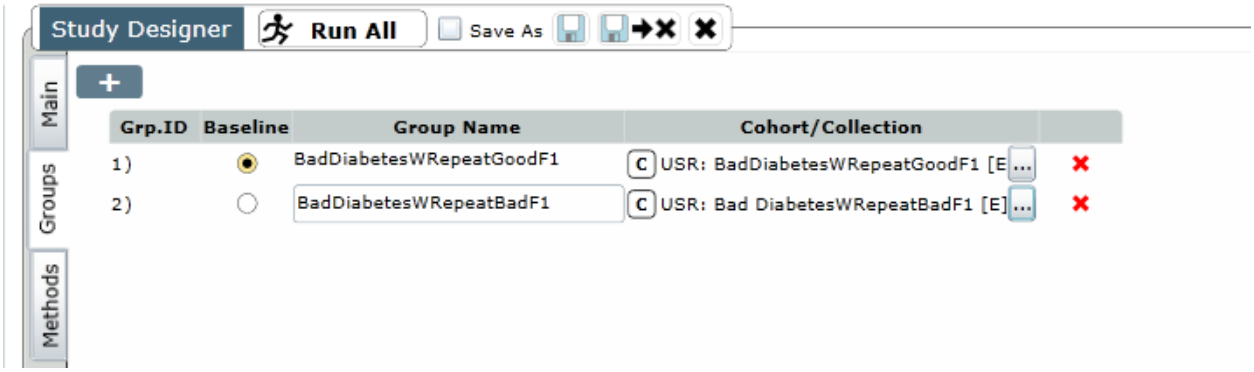
Fortunately, we have already built cohorts with the focus on line 1. They were saved as “BadDiabetesWRepeatGoodF1” and “BadDiabetesWRepeatBadF1”.

Choose from the drop down in study designer “BadDiabetesWRepeatGoodF1”

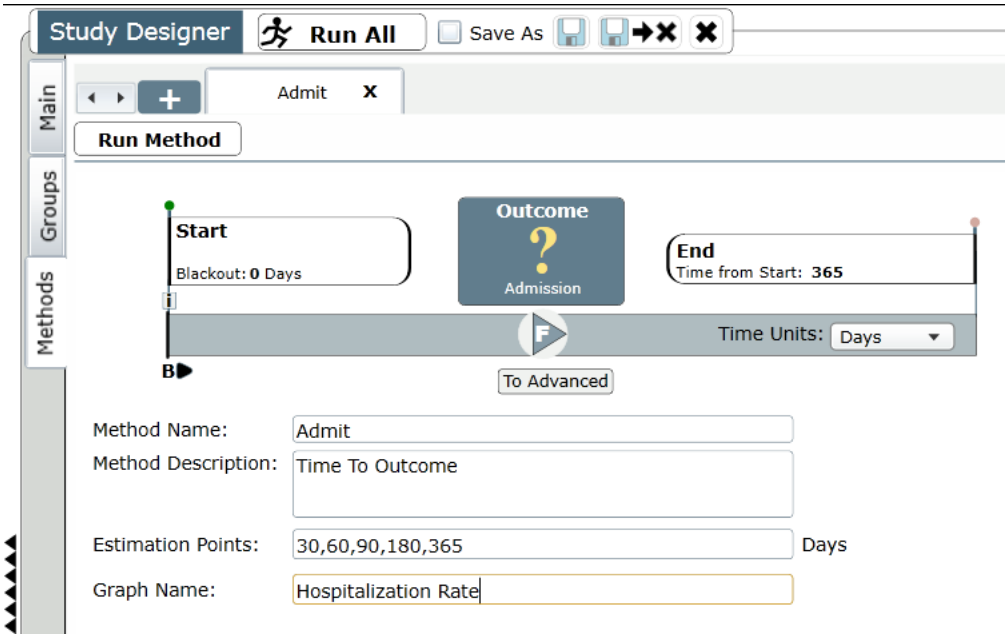


Add another group choosing “BadDiabetesWRepeatGoodF1” from the drop down.

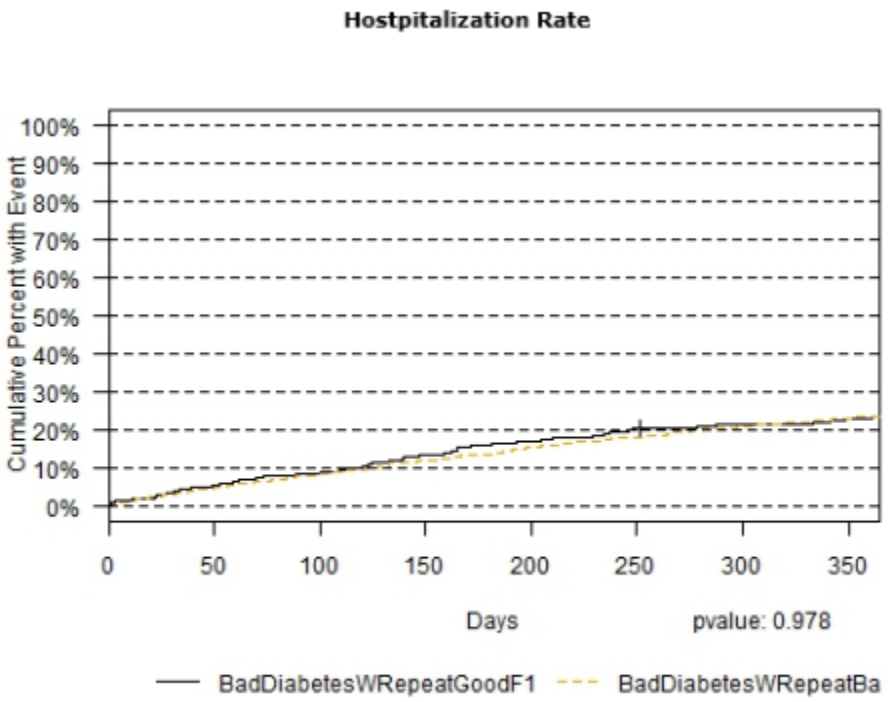
Name both groups using their drop down name.
Resulting in:



Add a Time to Outcome Method. (if you forgot how, look at previous pages)



Now run:



Cummulative % with Event	30 Days	60 Days	90 Days	180 Days	365 Days
BadDiabetesWRepeatGoodF1 (baseline)	**3.8%** (1.8,5.7)	**6.7%** (4.1,9.2)	**8.3%** (5.5,11.1)	**16.1%** (12.3,19.7)	**23.3%** (18.9,27.5)
BadDiabetesWRepeatBadF1	**3.1%** (2.0,4.1)	**5.7%** (4.3,7.2)	**8.0%** (6.3,9.7)	**13.6%** (11.4,15.7)	**23.7%** (21.0,26.2)

In this analysis we are following patients for 365 days from their initial diagnosis and asking for the hospitalization rate during the time we are trying to bring their blood sugar under control. The graph is comparing the hospitalization experience for the two groups based upon their ultimate control status.

- One group will ultimately be well controlled.
- And, one group will ultimately be badly controlled.

We are comparing the hospitalization rate for both groups during initial time when their doctors are initially struggling to control their diabetes.

What do we notice? In the first 365 days we see no difference in hospitalization rate (p= .978). This is reassuring in that it suggests that the two cohorts are comparable at baseline and that what we have seen post therapy in hospitalization rates was the result of the control, not to baseline differences.

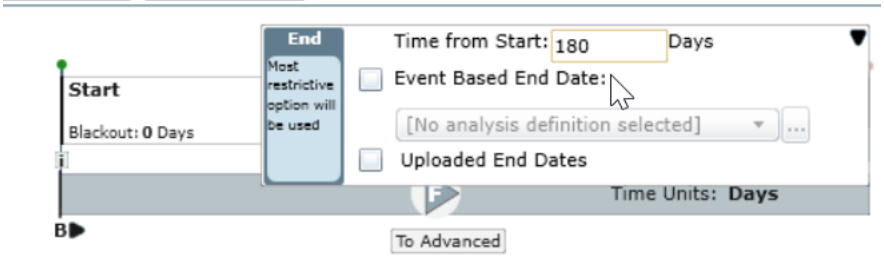
But wait, look closely at the graph above and the table at 180 days.

By day 180, 16.1% of those fated to be in good control were hospitalized at least once, whereas 13.6% of those fated to be in bad control were hospitalized at once.

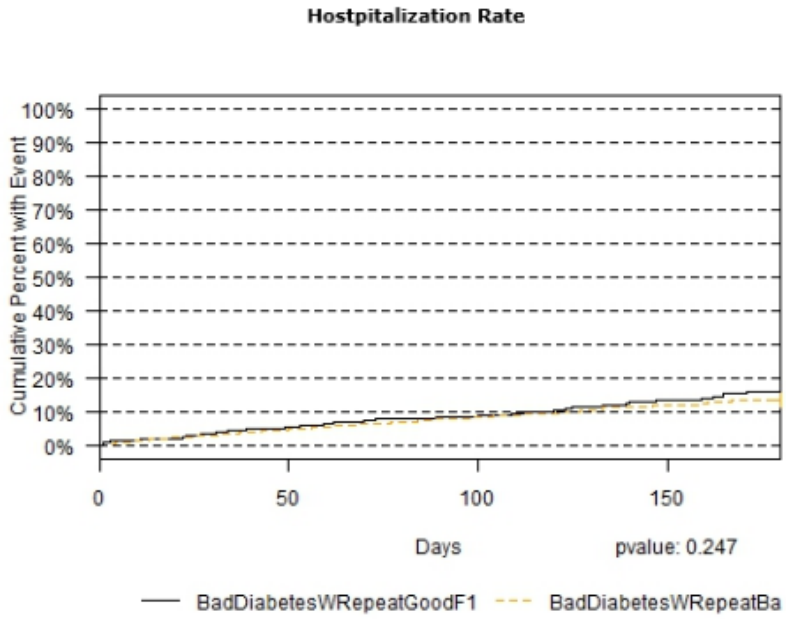
Surprisingly, the good diabetics are hospitalized at a faster rate than the bad diabetics.

Let's see how strong this observation is. Let's repeat the Time to Outcome analysis but modify the follow up time in the End Flag to 180 days.

This will let us compare the relative hospitalization rates in the two groups considering only the first 180 days of follow up time.



Yielding:



Cummulative % with Event	30 Days	60 Days	90 Days	180 Days	365 Days
BadDiabetesWRepeatGoodF1 (baseline)	**3.8%** (1.8,5.7)	**6.7%** (4.1,9.2)	**8.3%** (5.5,11.1)	**16.1%** (12.3,19.7)	- (-,-)
BadDiabetesWRepeatBadF1	**3.1%** (2.0,4.1)	**5.7%** (4.3,7.2)	**8.0%** (6.3,9.7)	**13.6%** (11.4,15.7)	- (-,-)

There is still no statistically significant difference between the two groups but we see something that looks paradoxical. Those who achieve good diabetes control have a higher hospitalization rate. We might hypothesize that those who were brought under good control suffered from more hypoglycemia and hypoglycemia associated hospitalization.

There is a short term cost in hospitalization in order to get the long term benefit.

Of course, the difference is not statistically significant in the short term so we really should not be making too much of this.

This exercise has demonstrated the impact of the focus of the index event line (which condition line the index event line points to) on the nature of the question answered when the cohort is enrolled in the Time to Outcome Study.

The cohort index date, carries within it the seeds of determining the question answered by the Time to Outcome Study in Study designer. You must think carefully when you build your cohort, anticipating the nature of the question that you plan to answer. (See Riddles in Accountable Health Care Chapter 5 – Heads or Tails which End is up).

Time to Outcome Advanced Method

First Recapitulate Results of Simple Method with Advanced Method

Tutorial #17 Time to Outcome Advanced Method

https://www.youtube.com/watch?v=d8i9XocczLQ&index=17&list=PLf7raPnmlLOeAWU2cNf2jIMDRqQuUTCum

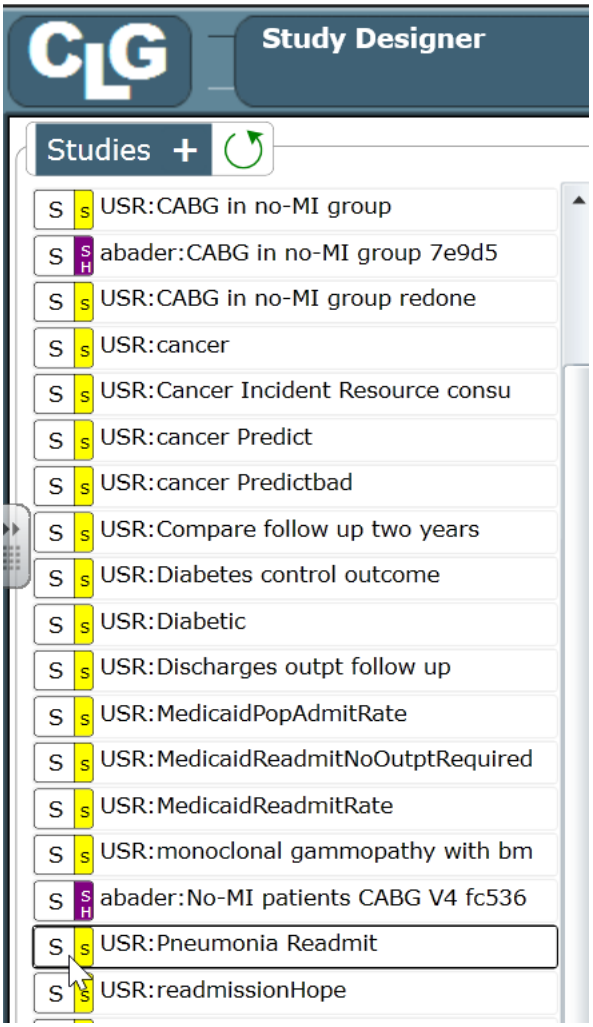
To transition from the simple method to the advanced method in study designer, we will first redo the pneumonia study you performed in the simple method using the advanced method. Once we have used the Advanced Method, we will compare the results with the Simple Method and show you where they are the same and where they are different. We will then proceed to evaluate a problem for which the Advanced Method is necessary to solve the problem.

You are familiar with the racetrack paradigm of study designer:

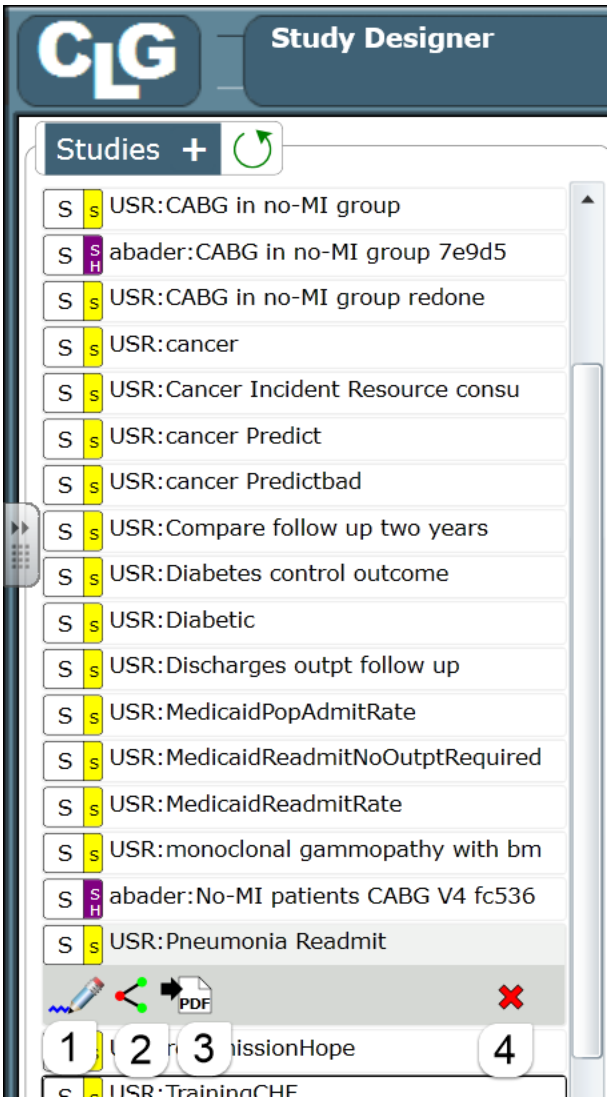
Let's open up our old *Pneumonia Time to Outcome Study*.

Go to Study Designer.

The management pane appears.



Left click on the S of the study “Usr: Pneumonia Readmit”. Usr is the prefix given to the studies that you have built.



Four images appear:

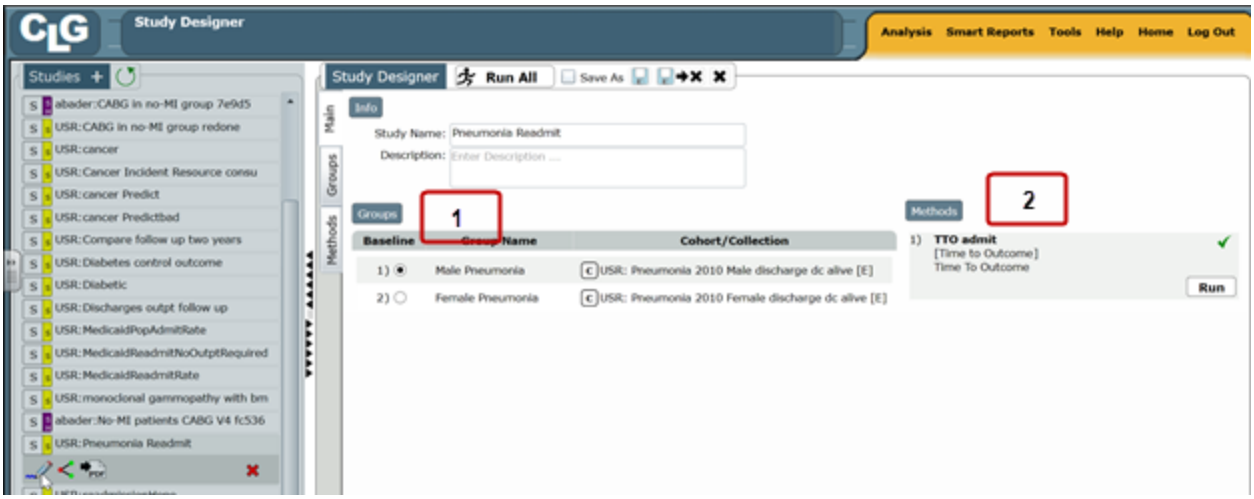
1- A pencil meaning edit allowing you to open the study, run it, or modify it

2- Share symbol lets you share your study with a colleague (mnemonic open arms sharing)

3- PDF – this will provide a pdf summary of your study without identifiers

4- Red X - if you left click on this, the study will be deleted and unrecoverable.

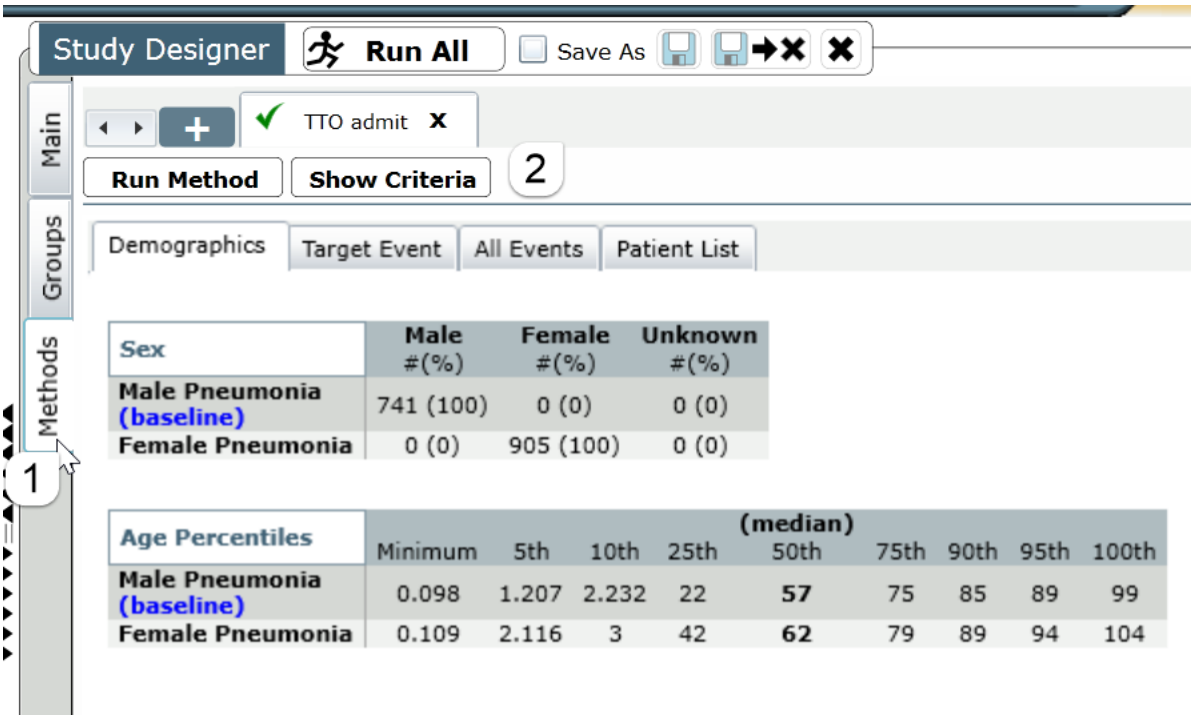
Left click on the pencil and the study designer canvas opens to the right of the Management Pane.



Note you are opened directly to the Main canvas of this study, showing you the study objects.

1. On the left are the groups
2. On the right the Methods applied to the groups. In this case, there is only one method.

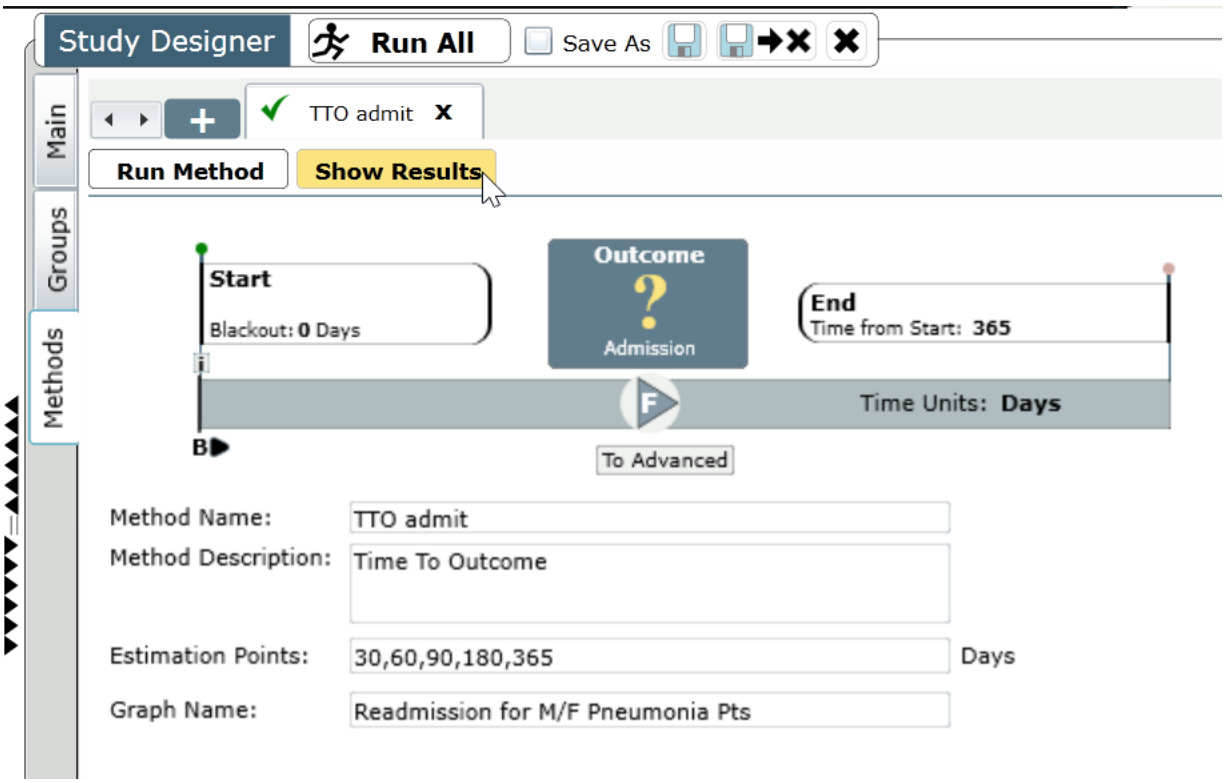
Left Click on the Method tab.



1- The Method tab becomes white and the other tabs gray out.

2- We note that the method canvas is open and displaying results in the results mode. That is why the (2) “Show Criteria” button is offered. You can easily toggle between the criteria used to build the study and the results of– method of “TTO admit”

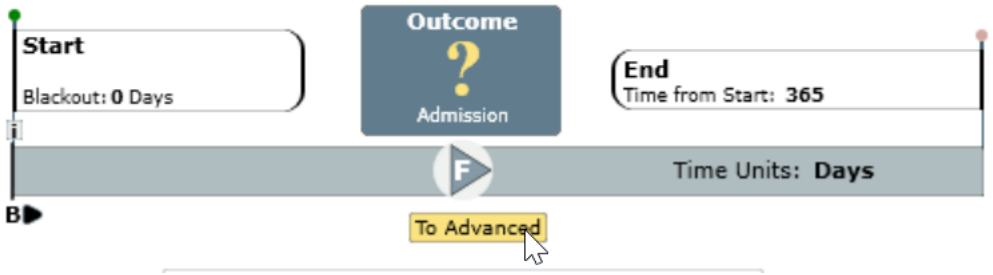
2- Left click on Show Criteria and you will find the criteria view and the button you just depressed changes its name to “Show Results” letting you know you can switch back to results by Left clicking.



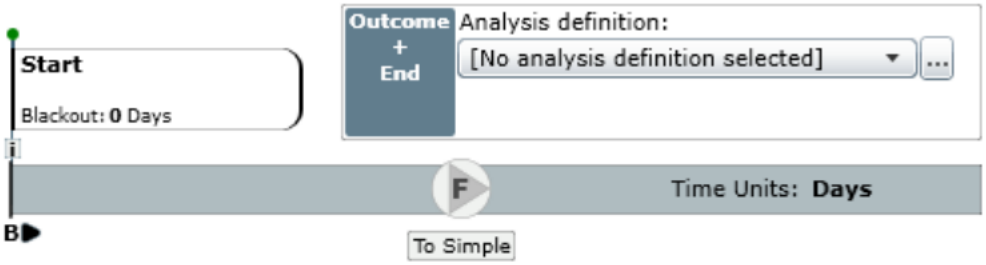
You are now in the racetrack paradigm on the Method Canvas.

Note at the bottom of the racetrack is the phrase “To Advanced”.

Hover over “To Advanced”, and the button becomes yellow showing that it can be pressed (left click).



Left click on “To Advanced” and a new image appears:



You are now in the Advanced Mode.

At the bottom of the “Advanced Mode racetrack metaphor “ is the toggle button that brings us back to the “Simple” mode.

Toggle back and forth between the simple mode and the advanced mode.

Go on, do a few more times. Have a blast!

The Advanced mode paradigm is similar to the simple mode. Like the Simple Mode, the Advanced Mode has a start flag.

The Advanced Mode has an end flag of sorts but its end flag is HUGE.

Unlike the Simple Mode, the Advanced Mode does not have an Outcome Event Box.

Somehow in this "HUGE End Flag" contains information for both the **Outcome Event and the notion of elapsed time**.

This will give us tremendous flexibility.

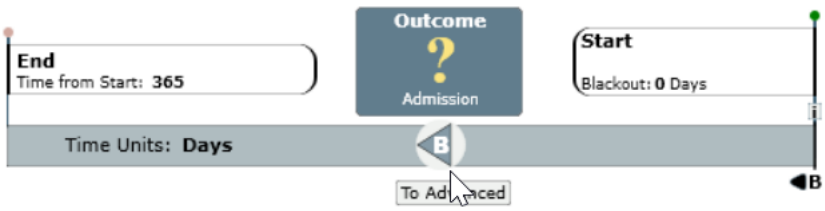
This "Huge End Flag" is called an "**Analysis Definition**".

The "**Analysis Definition**" contains information about elapsed time and whether the event is Earliest or Latest.

IMPORTANT POINT Simple Mode Assumptions Made Explicit

The simple mode is simple to enter but makes certain assumptions. Time is measured in the forward direction from the index date until the *first* downstream event. The most proximal event in the forward direction determines whether an event has happened or not.

When the direction of the racetrack is backwards, when we look prior to the index date to find an event (by pressing the F in the racetrack image, the F becomes a B)



The event that is now sought is the first event going backwards in time from the index date. This event is the most proximal event in the backward direction from the index date.

From the perspective of Time's arrow starting at 365 days before the index date and then ending at the index date, the event most proximal to the start date, will be the "latest event" in this window.

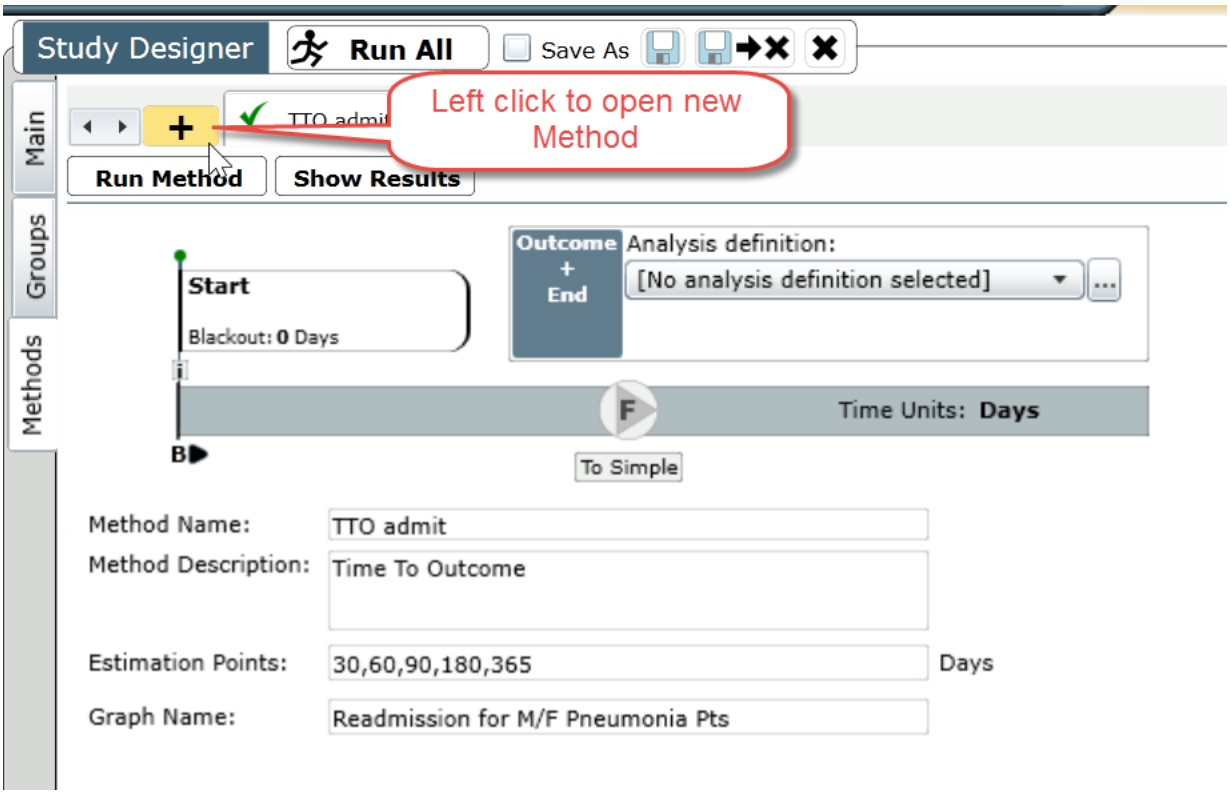
The power of the Advanced Method in terms of time is that it is able to select the latest or the earliest event in any time window. The Simple method can only detect the most proximal which means from the perspective of the calendar: Earliest in the forward direction, Latest in the backward direction.

In the Advanced Mode, the outcome event itself can be complex with multiple events or multiple temporal constraints as we shall later see.

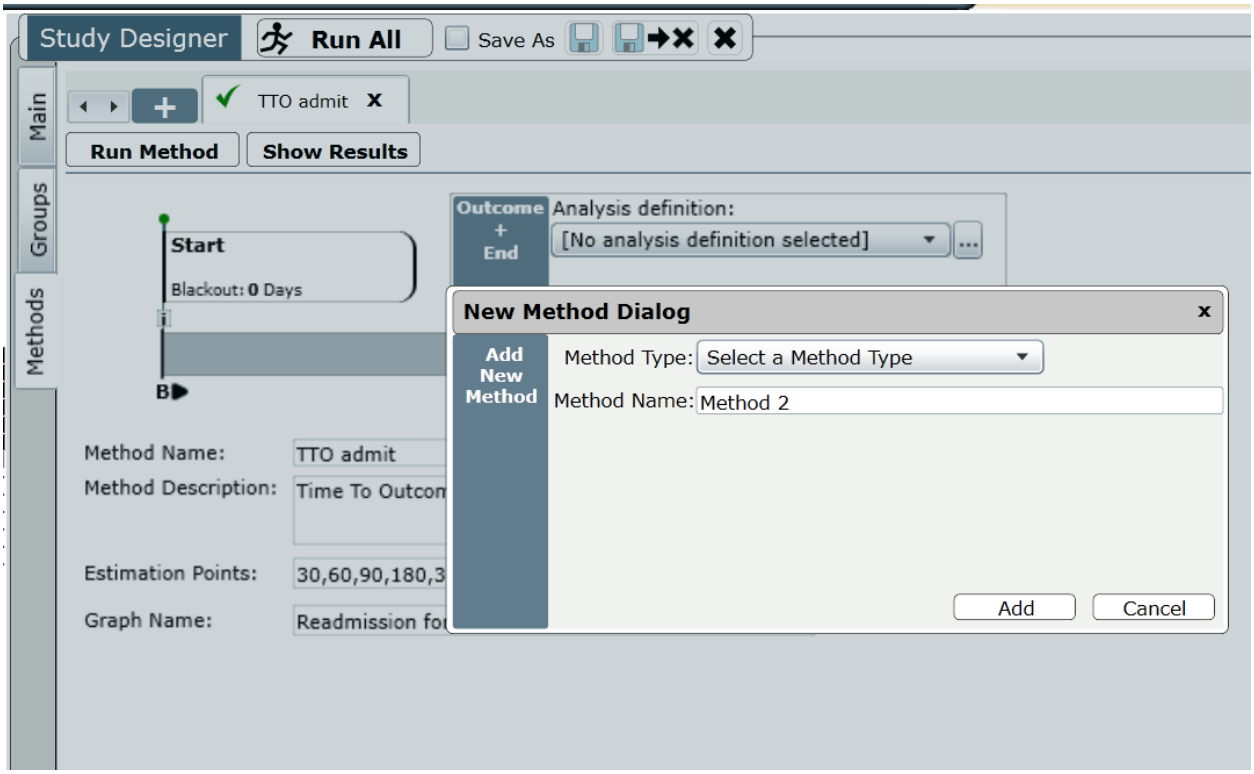
We will now build the same study in Advanced Mode that we built in the Simple Mode, using our pneumonia groups.

Instead, of modifying the current “TTO admit” method, we will add a new method and a new analysis to this study by Left clicking on the plus sign.

You are in Study Designer. Click the plus sign to add a new method.

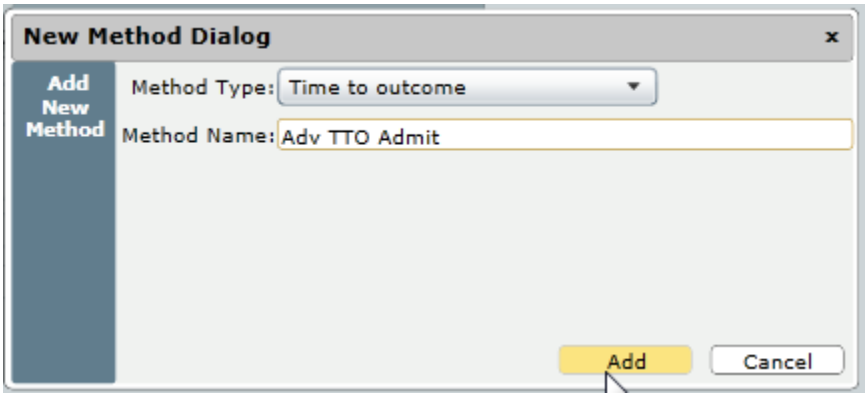


This yields:

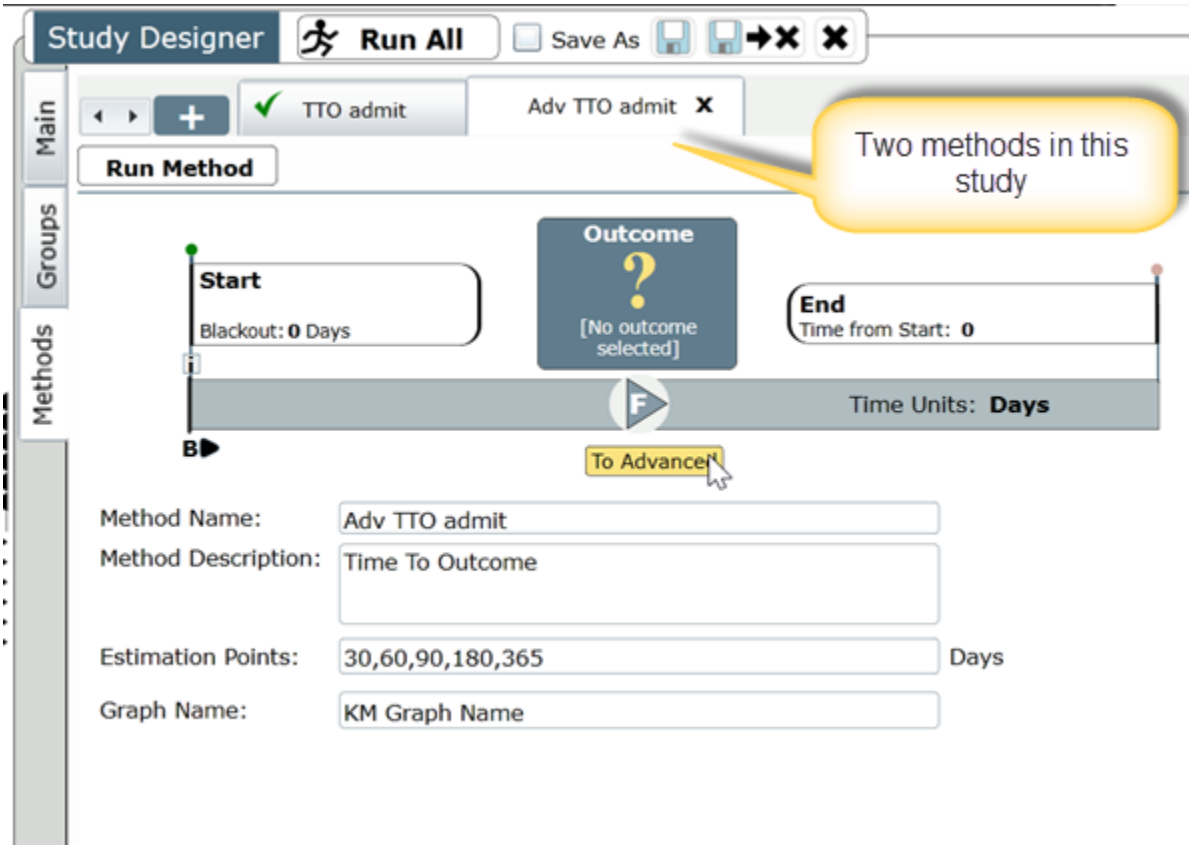


Choose as method Time to Outcome

Name the Method "Adv TTO admit", then add



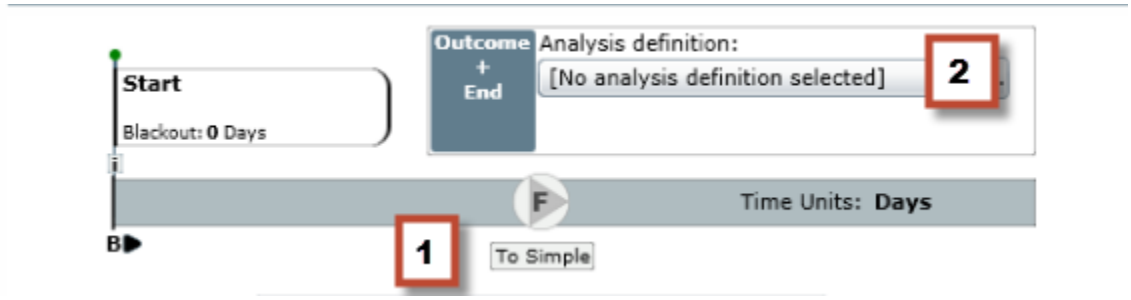
Notice that the new method is shown as a tab on the top of the Study Designer canvas. We now see two methods in the study. You see TTO admit **and** Adv TTO admit.



We now want to move from the “Simple” Method “To Advanced” Method. Hover over the “To Advanced” Button. The button becomes yellow.

Left Click on “To Advanced”.

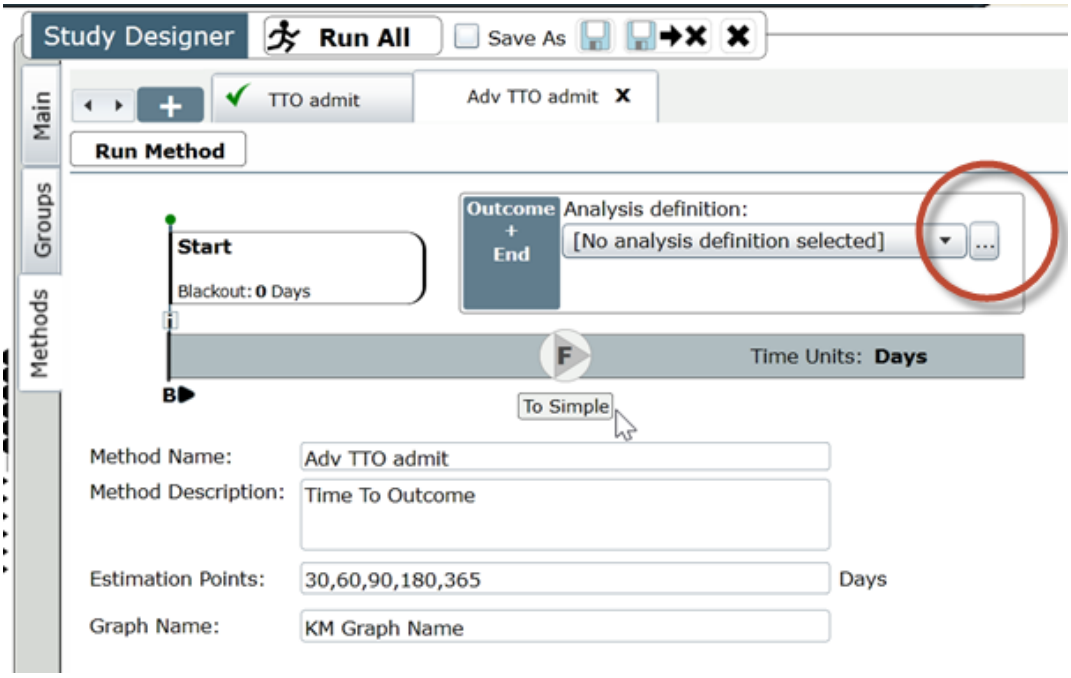
The racetrack image now changes to the Advanced mode:



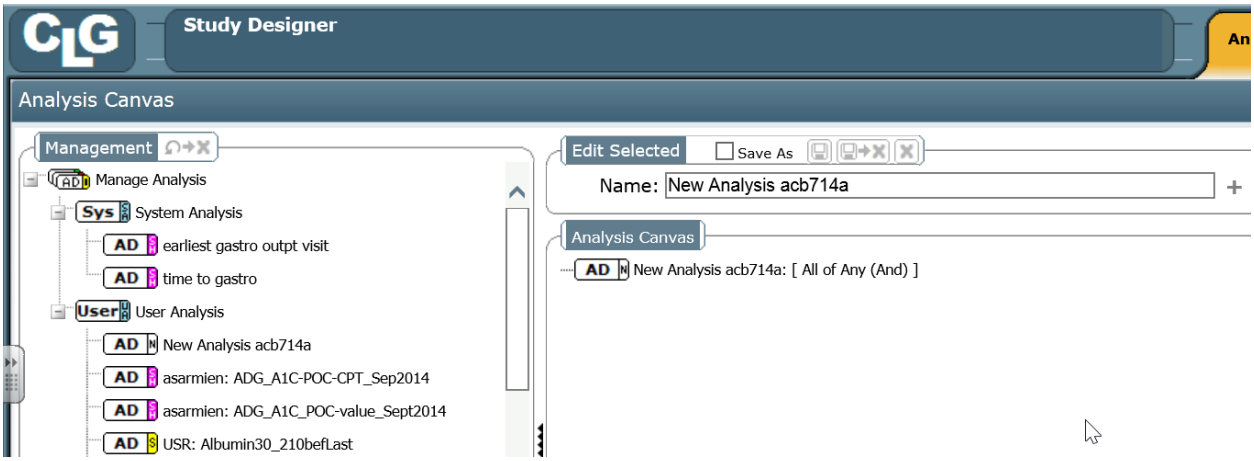
1. Note how the button that used to be “To Advanced” now becomes “To Simple”. This button is a toggle switch. Click on it a few times until you deeply appreciate what is happening.
2. Consider the rightmost flag - the Analysis Definition.

Recreate the same analysis in the advanced mode that we developed in the simple mode.

Right click on the three dotted button (see image below).



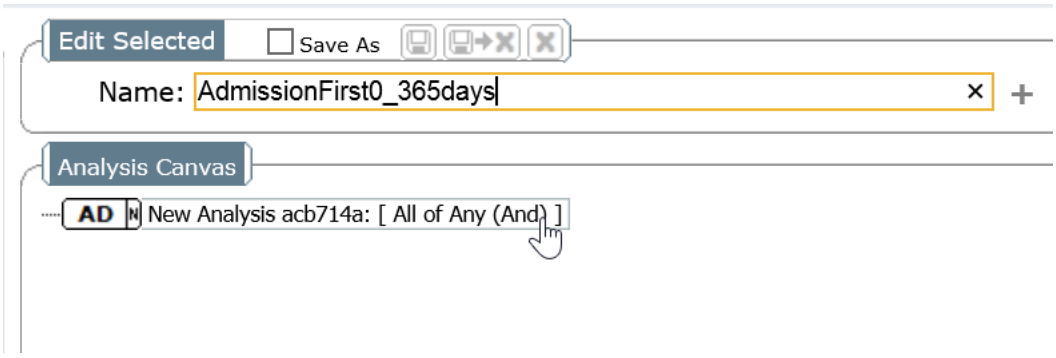
This opens the Analysis Canvas where we will build our Analysis Definition (AD).



Let's build an AD to imitate the simple method with:

- Elapsed time 0 to 365 days
- The *Earliest* Admission after the cohort index event date

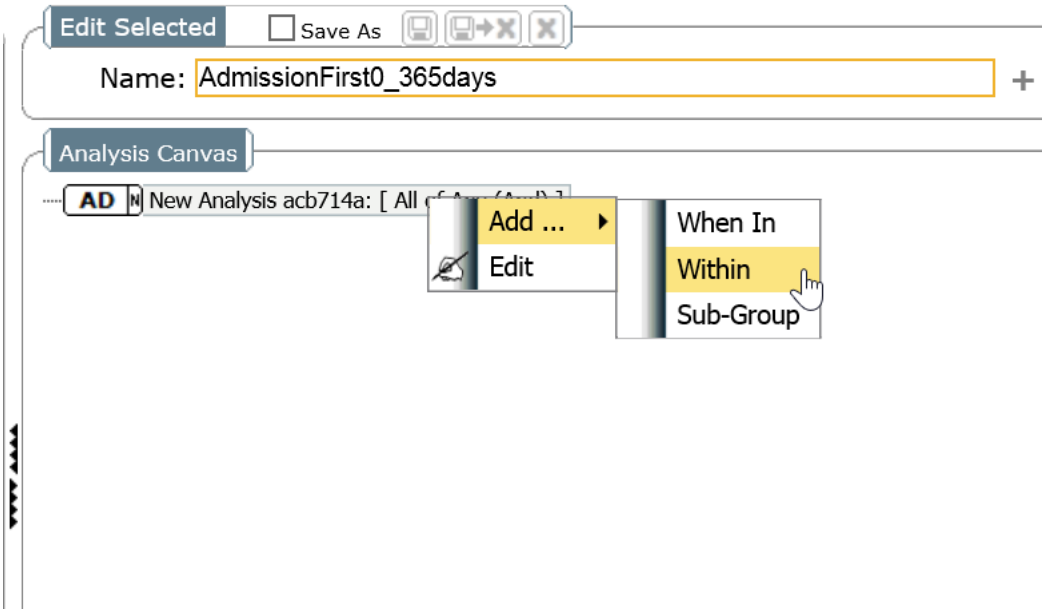
Like all canvases you hover over the Index Event Line and right click



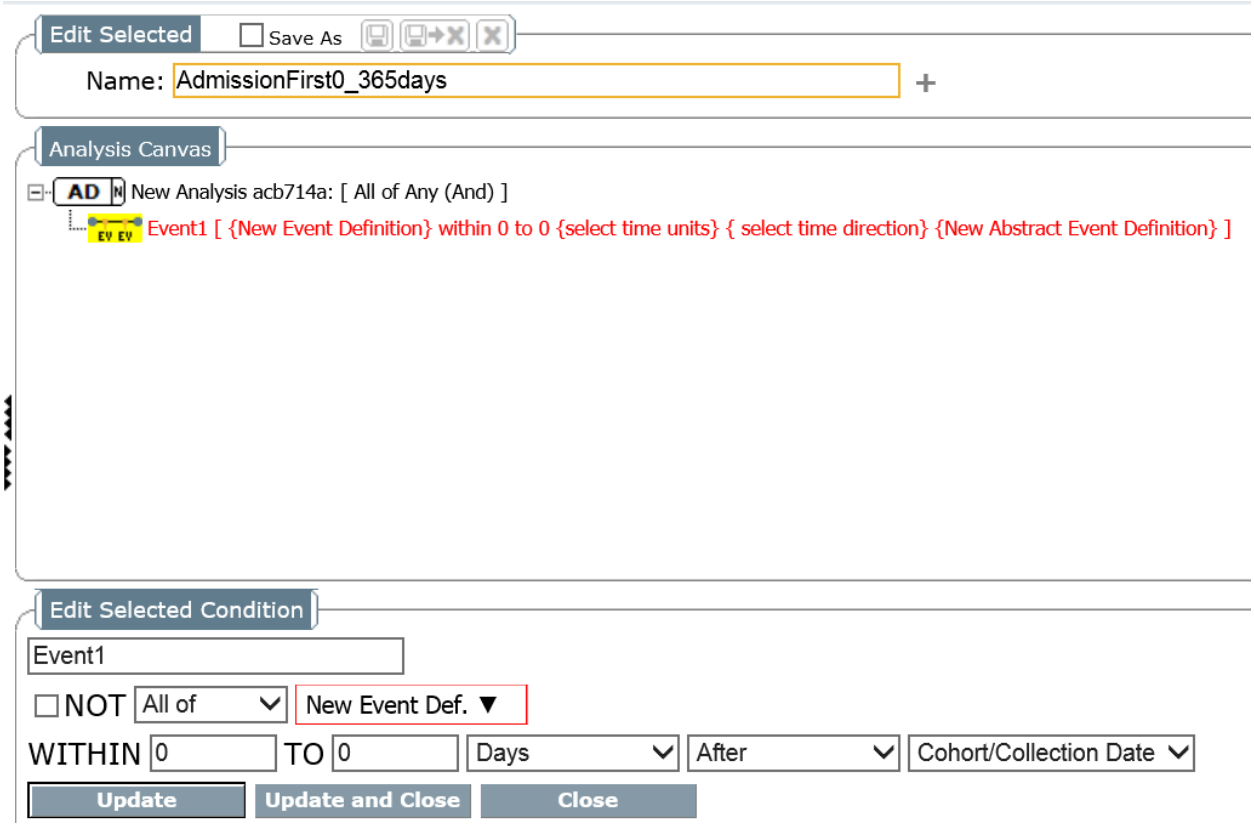
You are given the option to Add a condition to the canvas or to Edit the index event line.

Choose add a condition.

Since we want to compare admissions that occurred within 0-365 after hospital discharge, the new condition line on the canvas will be "Within".



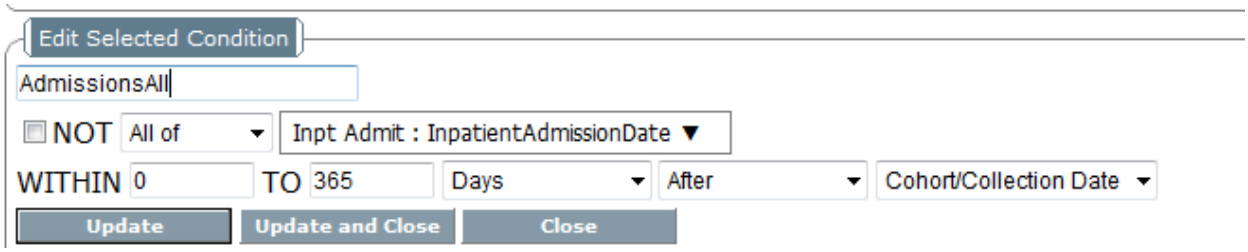
Now Left click on “Within. The new condition line appears on the canvas, and a GUI editor appears below.



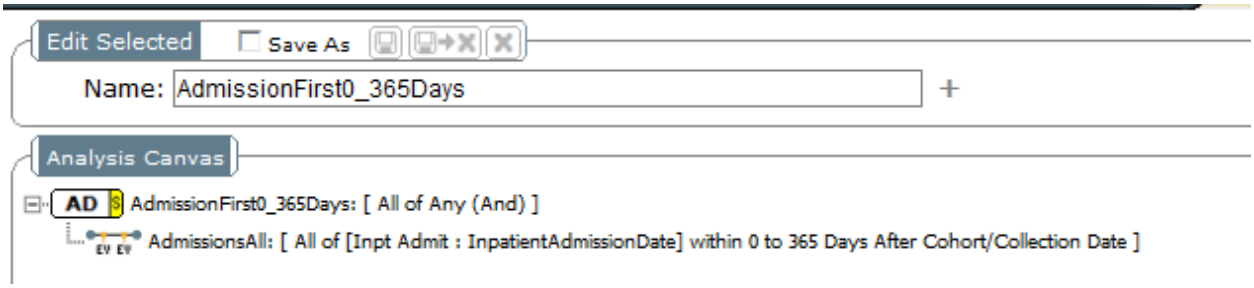
Fill in the gui editor as follows:

- Name the Event1 “AdmissionsAll”
- Leave the “All of” choice as is (we will later choose the first admission by using Earliest at the Index Event Line)
- New Event - Inpatient Admission (you will have to build this event as you have in previous exercises)
- Choose time: Within 0 to 365 Days
- The entry box after “After” points to “Cohort/Collection Date”. This instructs the condition line to point outside of the Analysis Canvas to the cohort member’s index date.

The resulting image in the GUI editor:

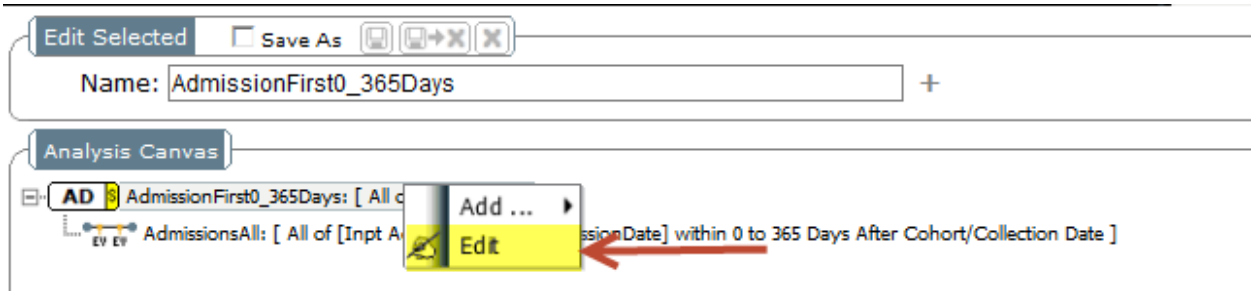


Update and Close.

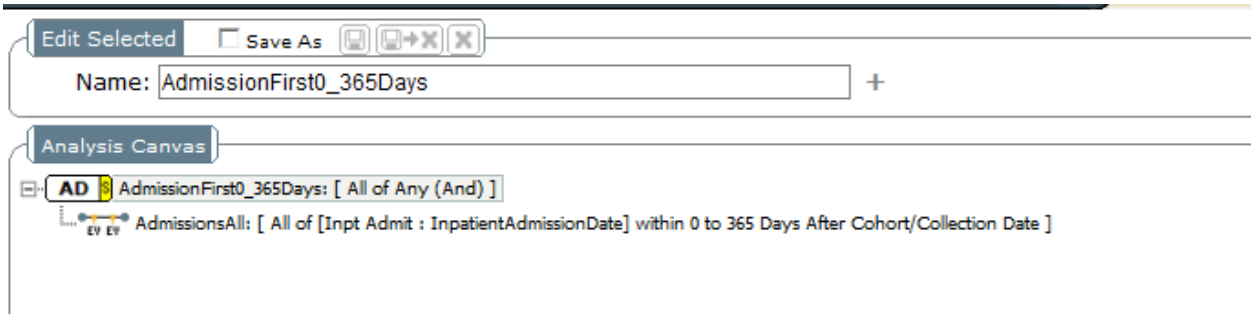

Edit Selected
Save As
Name:
AdmissionFirst0_365Days
Analysis Canvas
AD
AdmissionFirst0_365Days: [All of Any (And)]
AdmissionsAll: [All of [Inpt Admit : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]

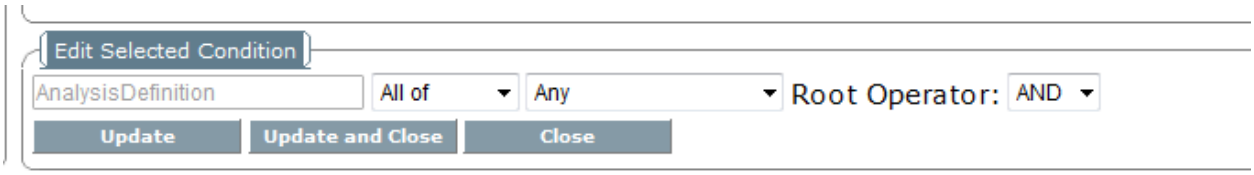
The Index Event Line still needs to be changed.

Hover over the Index Event Line and right click. Choose Edit.



The gui to edit the Index Line appears below the Analysis Canvas


Edit Selected
Save As
Name: AdmissionFirst0_365Days
Analysis Canvas
AD
AdmissionFirst0_365Days: [All of Any (And)]
AdmissionsAll: [All of [Inpt Admit : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]



We need to change the Index Event Line from “All of” to “Earliest of”.

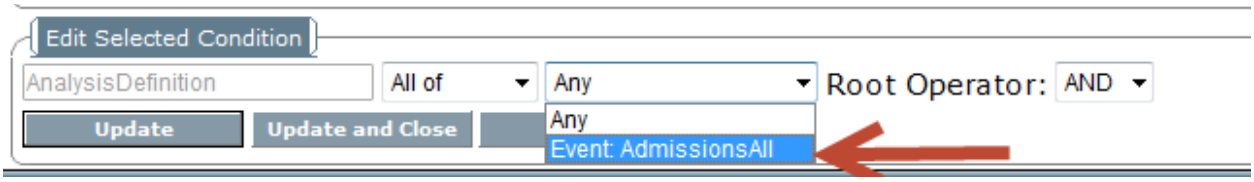
Earliest at the Index Event will choose the first admission.

A Time to Outcome Method must go to a “singularity” - a single event per person.

An Analysis Definition used in a Time to Outcome Method must go to either an “Earliest” or “Latest” Event. It must go to a singularity not to All.

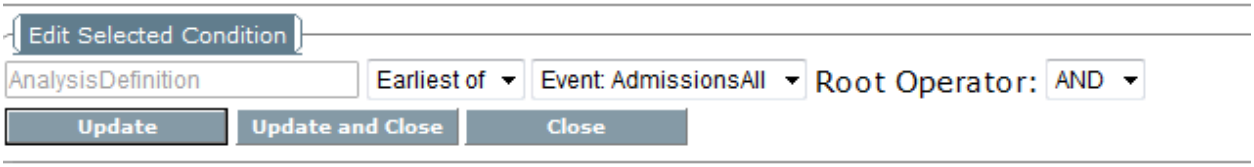
Only Analysis Definitions with “Earliest” or “Latest” (not “All of”) in the Index Event Line will show up in the Analysis Definition drop down menu in the advanced mode Time to Outcome.

Make the modifications in the GUI editor

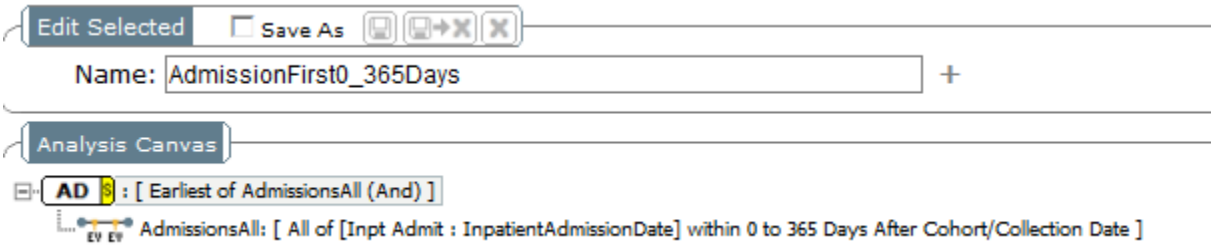


- Choose “Earliest Of”
- Change “Any” - to focus on the condition line of interest – “Event: AdmissionsAll”. Even though there is only one condition line, it is good practice to always point to the line of your interest.

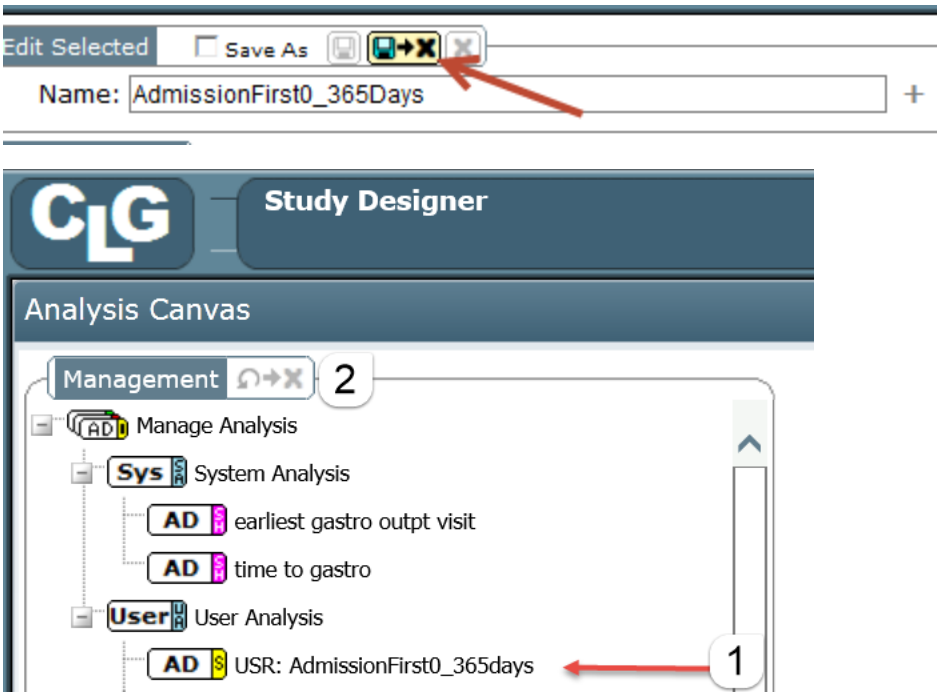
Resulting in:



Now update and Close and the Analysis Canvas Looks like:

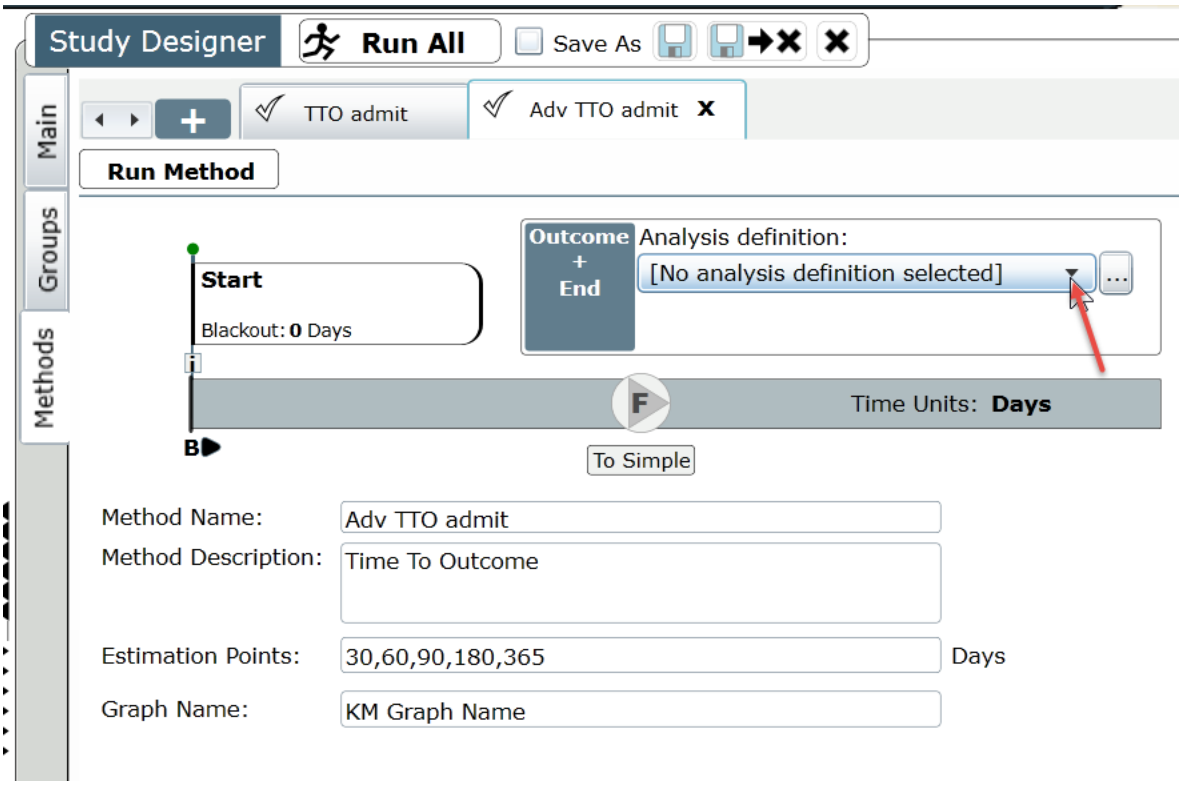

Edit Selected
Save As
Name:
AdmissionFirst0_365Days
Analysis Canvas
AD
: [Earliest of AdmissionsAll (And)]
AdmissionsAll: [All of [Inpt Admit : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]

Save and close and you will see your Analysis Definition in the Management Pane:

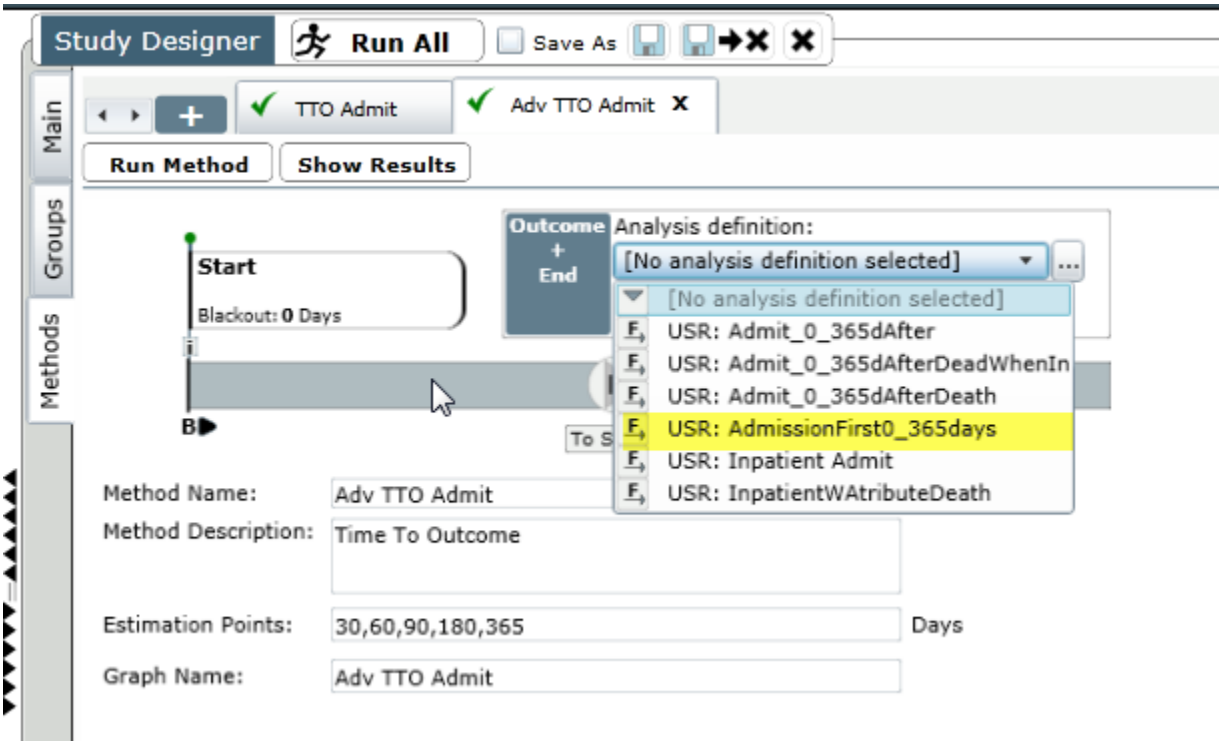


1- Note the Saved Analysis Definition (AD) in the Analysis Canvas Management Pane

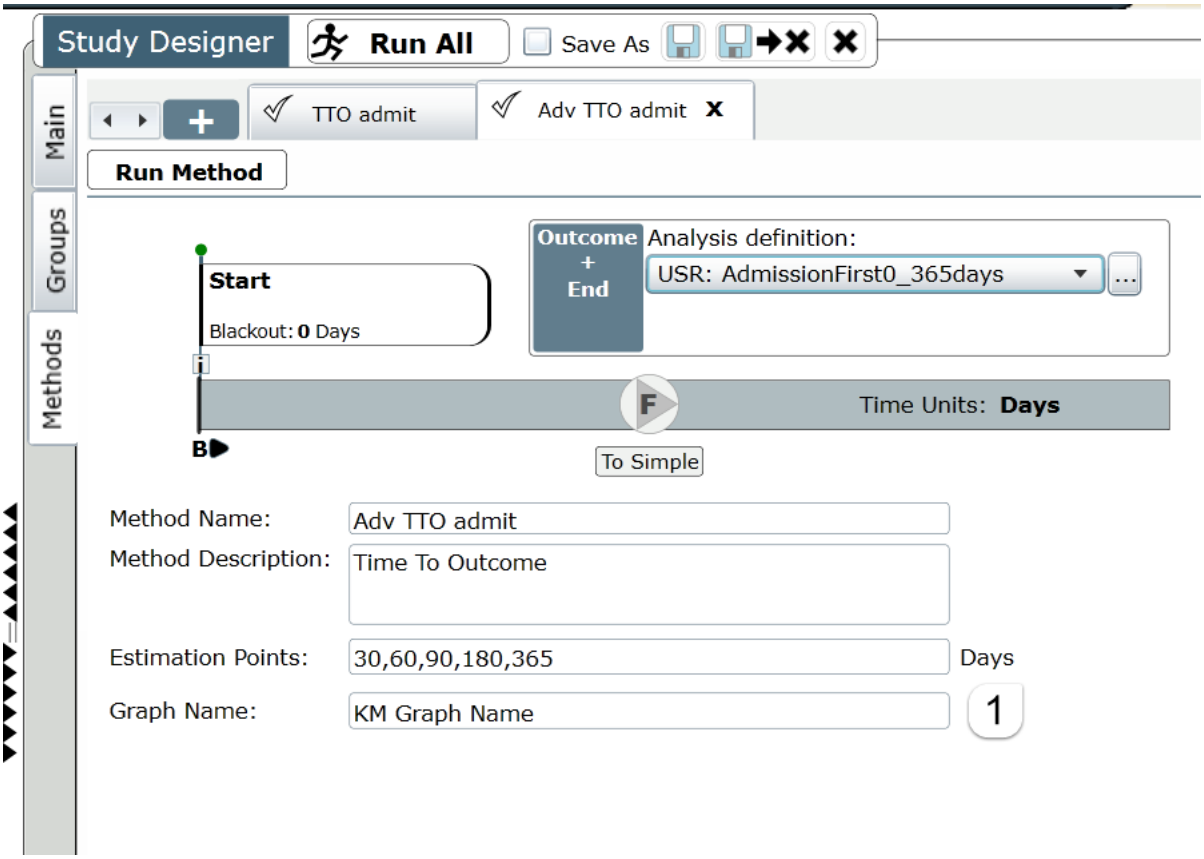
2- Now Exit and return to the study Advanced Method.



Left click on the drop down so we can choose the Analysis Definition.

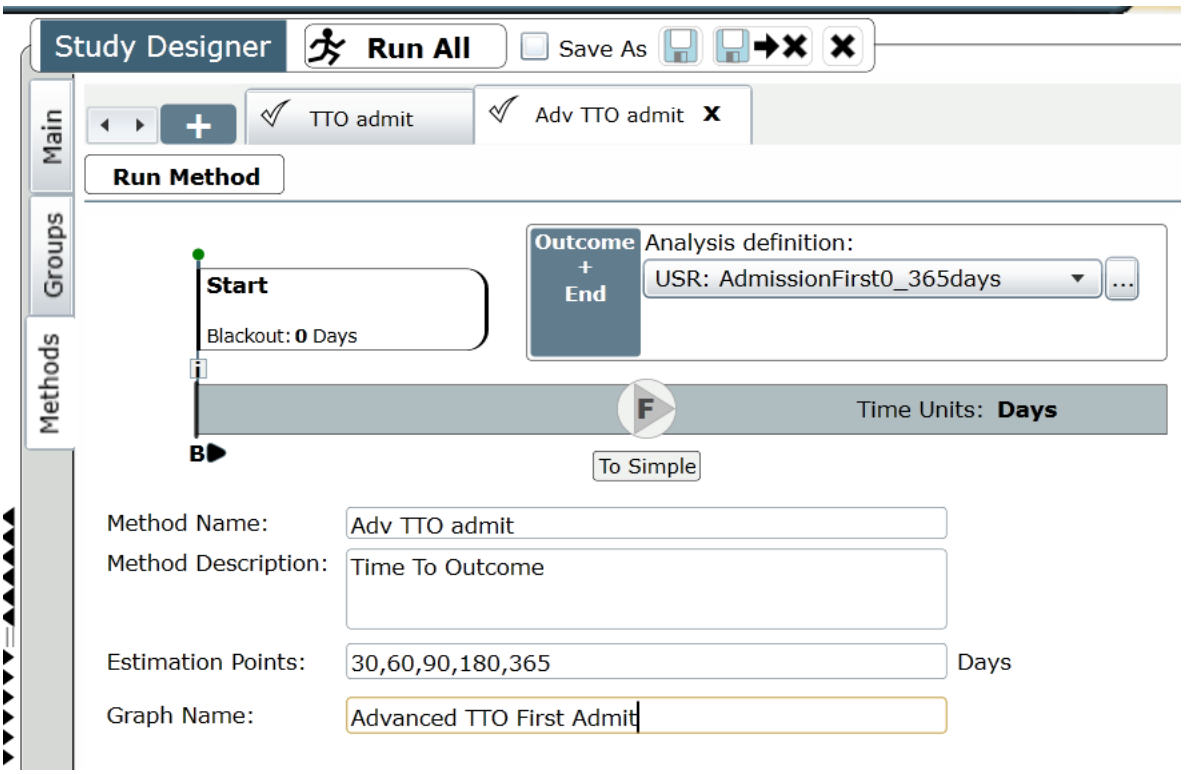


Resulting in:



Now rename the graph:

Advanced TTO First Admit

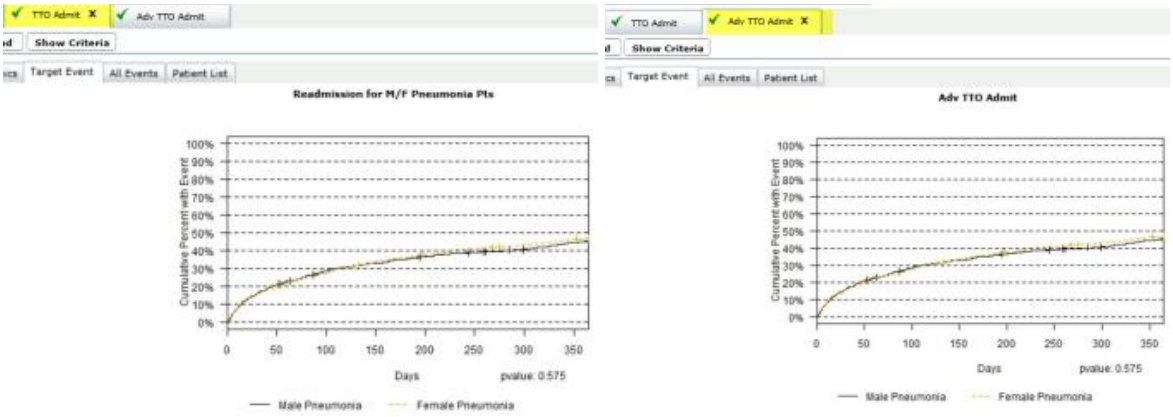


Run the Method

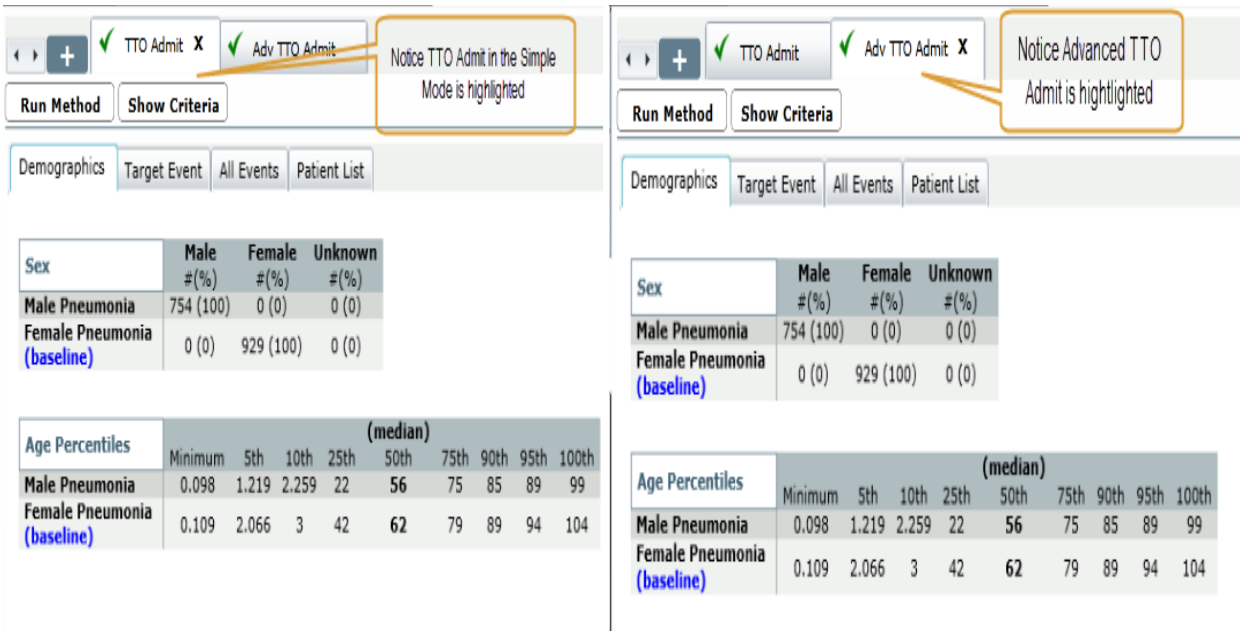
You can now compare in the “Target Event Tab” between methods “TTO admit” and “TTO Advanced” and find that the results are the same.

This means that the Advanced Mode when replicating the criteria of the Simple Mode gets the same result.

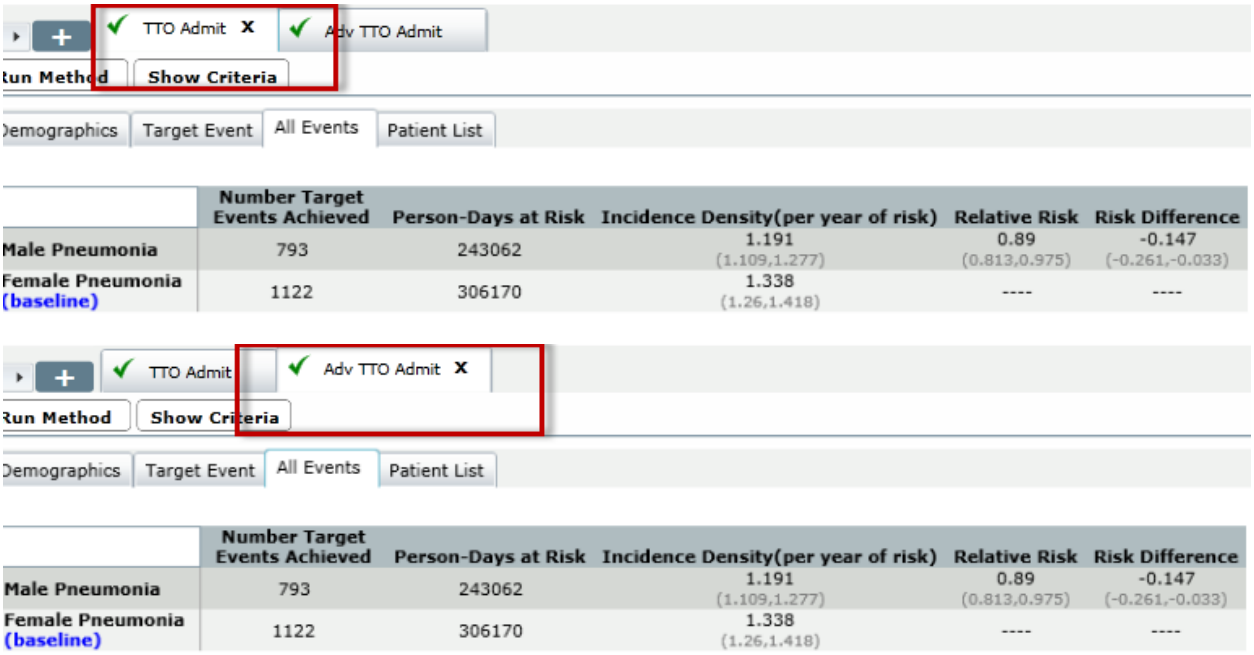
Target Events Tab in the Simple and Advanced Modes are identical – notice the highlighted tabs



Demographics between these two methods are the same.



All Events tabs between these two methods are the same.



Note that can be skipped on first reading:

The "All events" tab in study designer reruns the Analysis definition but changes the index line of the Analysis definition from "Earliest" to "All of".

Since the first condition line on the event canvas is "All of" the Advanced and Simple mode yield the same result in the All events tab. Should the first condition line be "Earliest" then the Advanced Mode would only count the first admission for each person while calculating all the follow up time for the incidence density calculation.

Let us re-review what an analysis definition is in the context of Time to Outcome Method.

The analysis definition attaches an event to the cohort.

The analysis definition counts time from the cohort's index date until the event of the analysis definition.

In our example, the analysis definition attaches the first admission after cohort's discharge date to the cohort.

In our example, the analysis definition measures elapsed time from the cohort's discharge date to the first subsequent admission.

The analysis definition is measuring elapsed time from the cohort discharge date until the first admit date:time.

You might wonder why we bother with an advanced method if we can obtain the same results in the simple method….

There are things you can do with the Advanced Method that are impossible with the simple method:

1. You can do a time to outcome to the "latest" not just the "first"
2. You can build multiple condition lines in the Analysis Definition (impossible in simple method)
3. In list method (next lecture) you can use "All of " not just "Earliest" or "Latest")
4. In list method (next lecture) you can use a "when in duration" to list things that occur during the hospitalization.

Now let's proceed to show why the Advanced Mode is important.

Let's create an Analysis Definition where there are two condition lines (something impossible in the simple method).

Complex TTO Examples requiring an Advanced TTO

Tutorial #18 Time to Outcome Example requiring Advanced Method
https://www.youtube.com/watch?v=VChMwnymKCw&index=18&list=PLf7raPnmlLOeAWU2cNf2jIMDRqQuUTCum

Suppose we wanted to identify elapsed time from index until the first admission in which the patient died.

The target admission will not be the first admission if the patient did not die in the first admission. If the patient dies in the second admission, then the elapsed time goes from the index date of the cohort, until the admit date of the second admission which is the admission in which the patient died.

Our analysis definition requires that we indicate in some way that a death was involved in the admission that followed.

We can express death during a hospital admission in two ways.

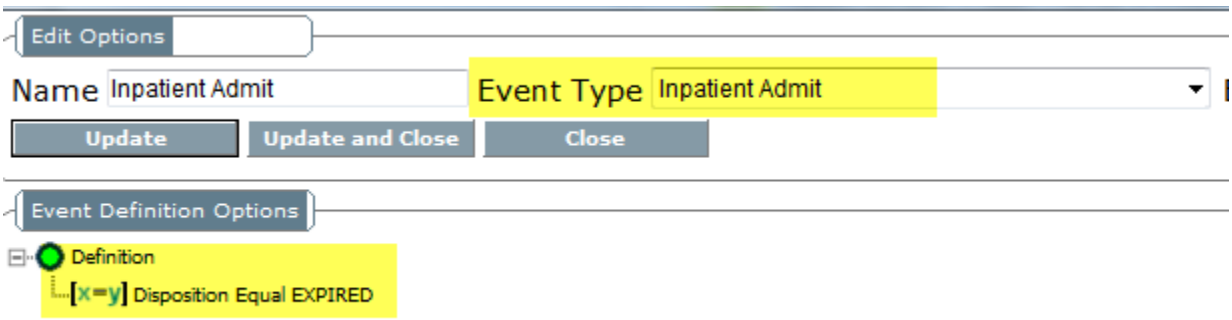
Approach #1

One approach is to appreciate that when a death occurs in a hospital admission**,** that admission is profoundly changed by the occurrence of death.

The admission is subsequently branded by the death during the admission.

The **attribute** of death will then be permanently associated with the hospital admit event.

A hospital admission with the attribute death can be defined by choosing an “inpatient admit” event type and then adding a definitional condition “Disposition = Expired”

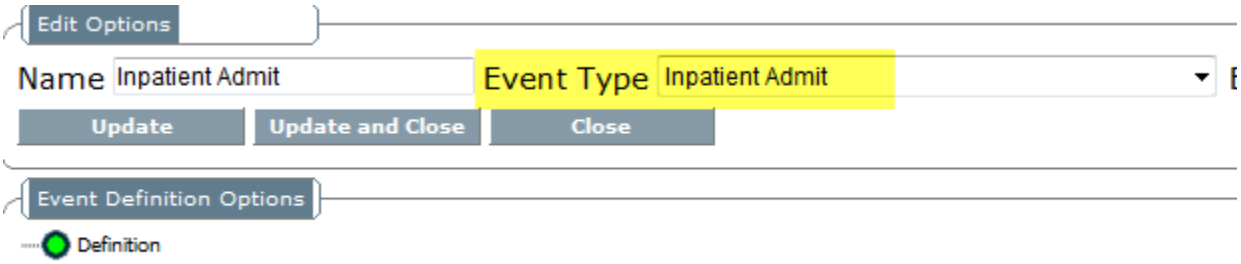


Approach #2

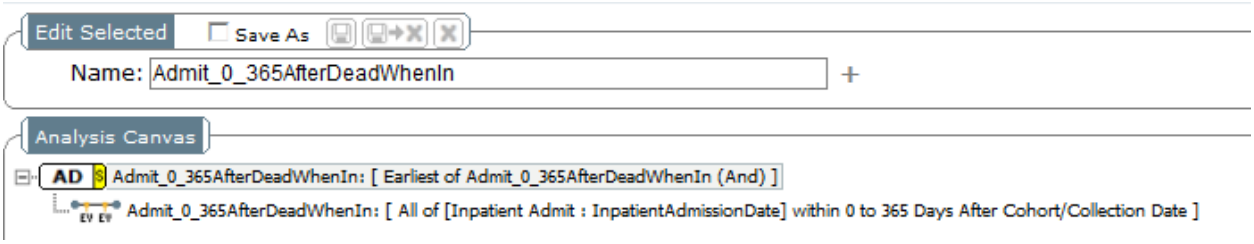
The advanced mode uses an Analysis Definition permitting many condition lines to define the event of interest. The simple mode only permitted a single event and not a series of related events.

The first condition line will be an **inpatient admission** without any condition of disposition = expired.

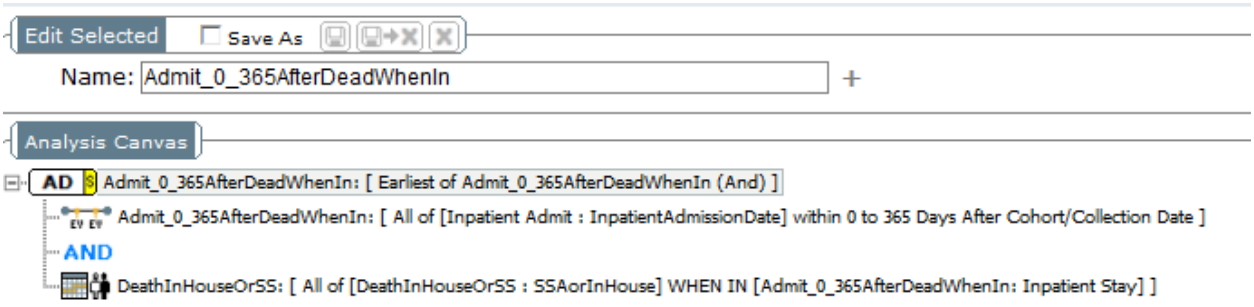
Note the event definition in the image below. There is no condition of disposition = expired.



You will build on the Analysis Canvas, two condition lines. The first has the condition of "inpatient admission"


Edit Selected
Save As
Name: Admit_0_365AfterDeadWhenIn
Analysis Canvas
AD
Admit_0_365AfterDeadWhenIn: [Earliest of Admit_0_365AfterDeadWhenIn (And)]
Admit_0_365AfterDeadWhenIn: [All of [Inpatient Admit : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]

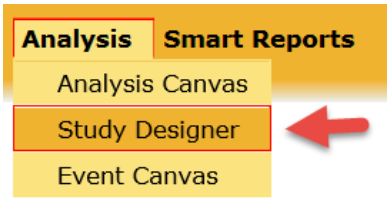
The second line has an event death that occurred during the admission, during (When In) the event of the first line.


Edit Selected
Save As
Name: Admit_0_365AfterDeadWhenIn
Analysis Canvas
AD
Admit_0_365AfterDeadWhenIn: [Earliest of Admit_0_365AfterDeadWhenIn (And)]
Admit_0_365AfterDeadWhenIn: [All of [Inpatient Admit : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]
AND
DeathInHouseOrSS: [All of [DeathInHouseOrSS : SSAorInHouse] WHEN IN [Admit_0_365AfterDeadWhenIn: Inpatient Stay]]

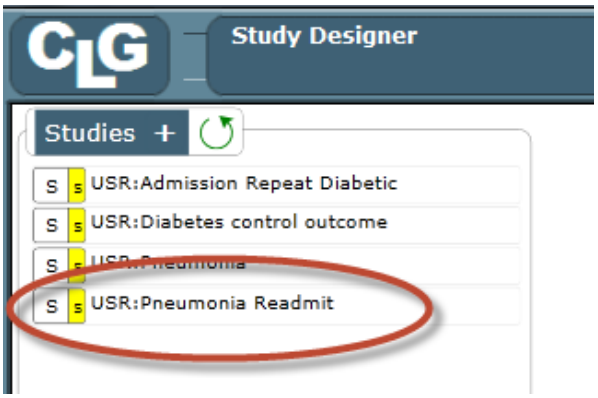
Let's begin:

First use Approach #1.

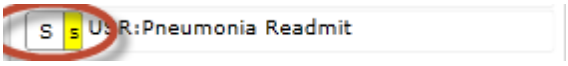
Go to Study Designer:



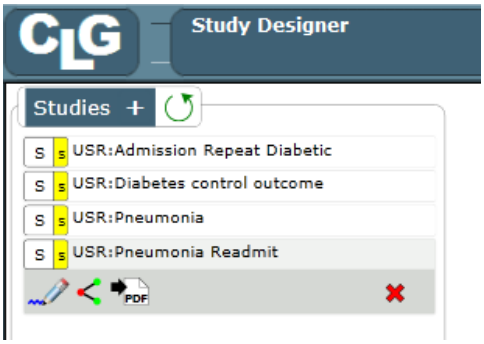
This opens up Study Designer.

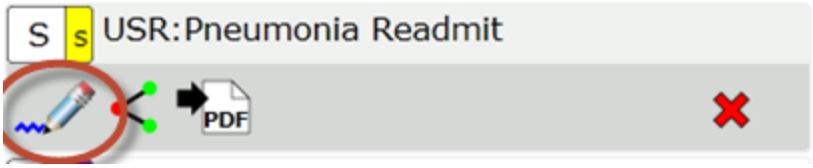


Left click on the S (study) for Usr:Pneumonia Readmit.



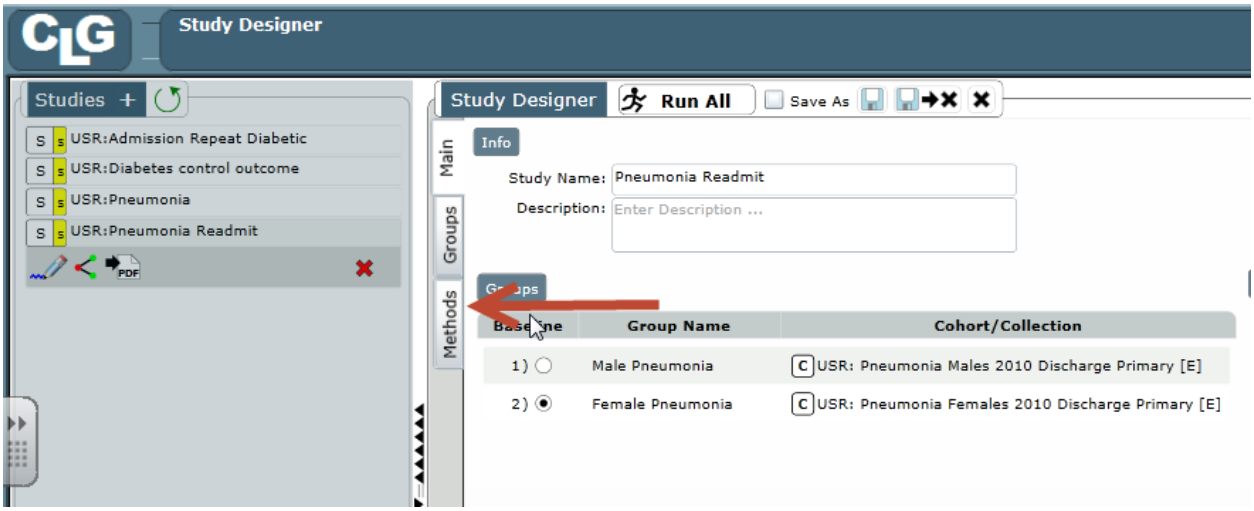
Left click on the pencil (study edit).



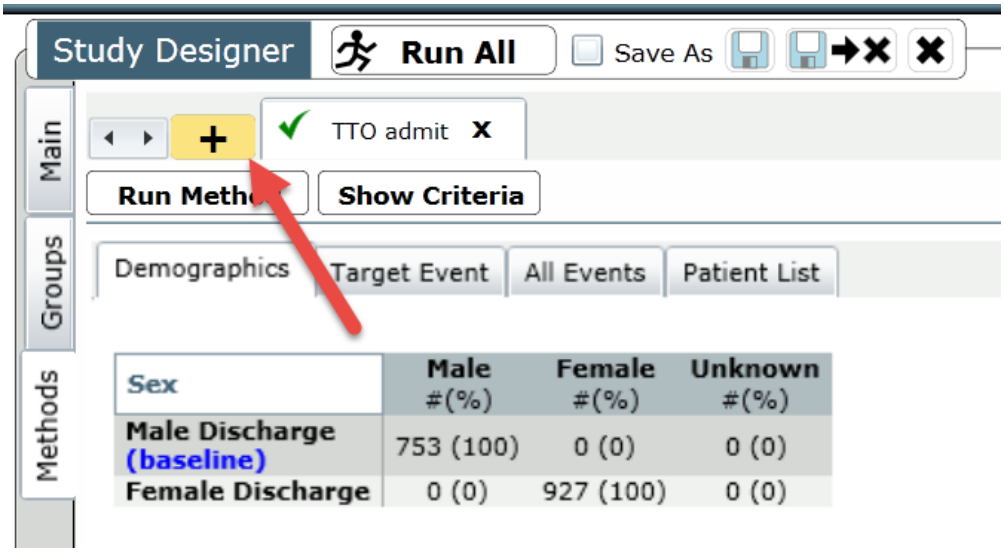


Your study opens.

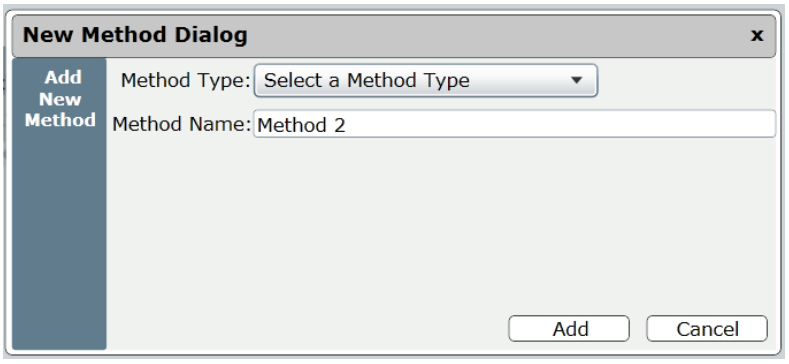
Click on the methods tab to create a new method.



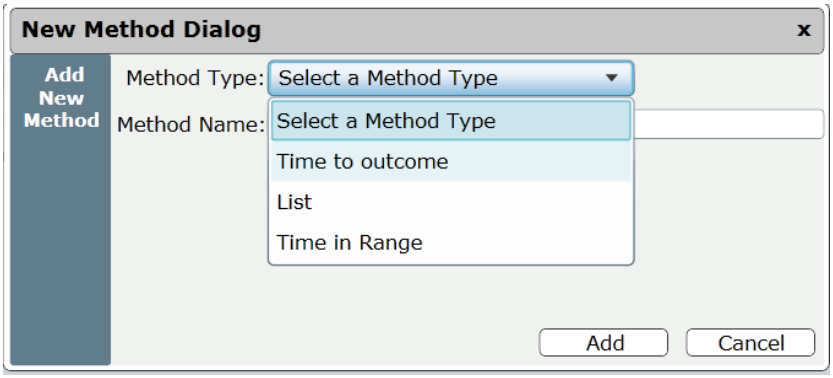
Add a new method by clicking on the plus sign.



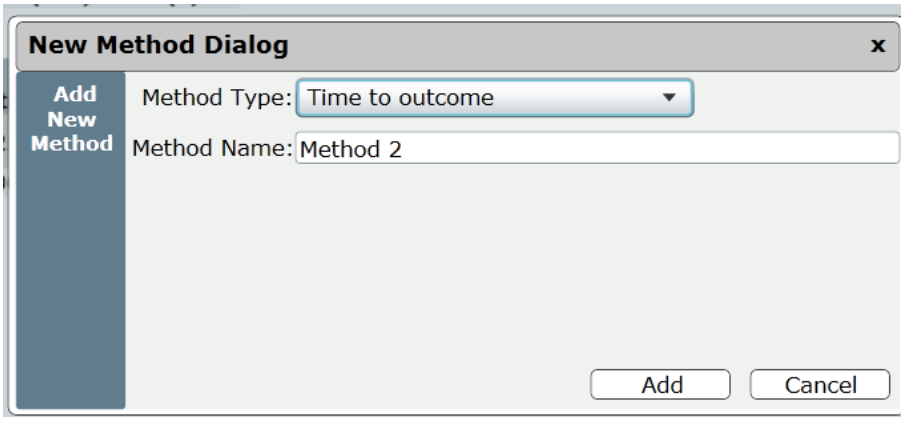
The new method dialog box will open.



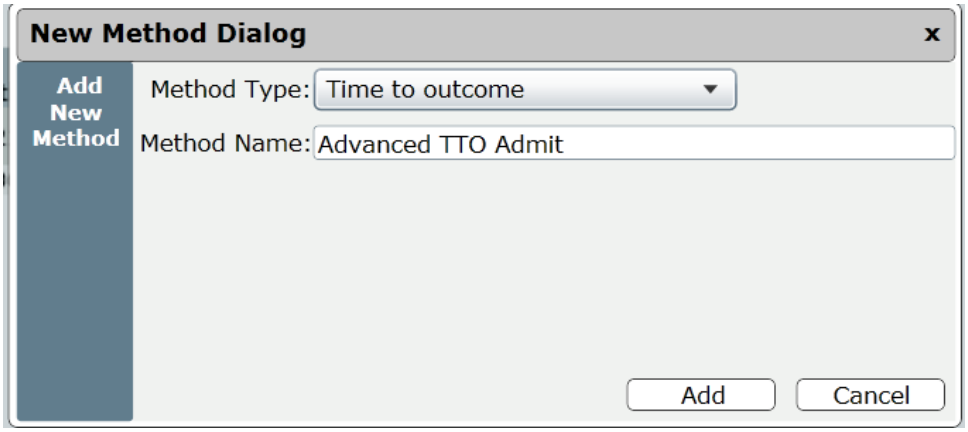
Left click on **Select your Method Type and choose Time to Outcome:**



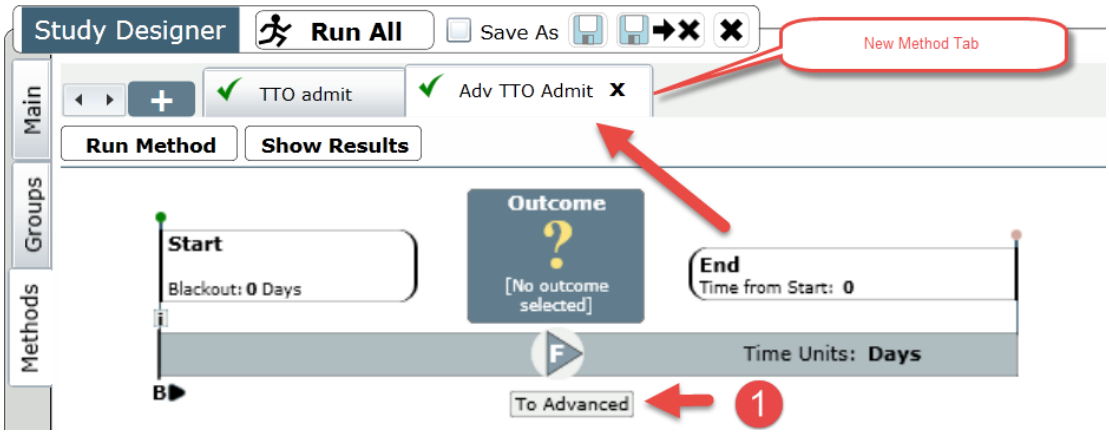
The resulting image is:



Rename the Method to: **Advanced TTO Admit**

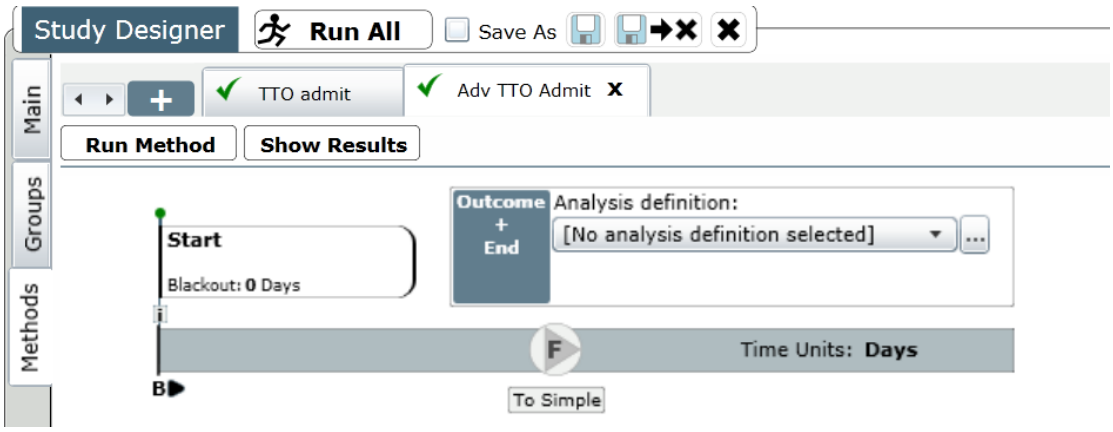


Click Add and your new method will appear as a tab in study designer.



Now click on To Advanced

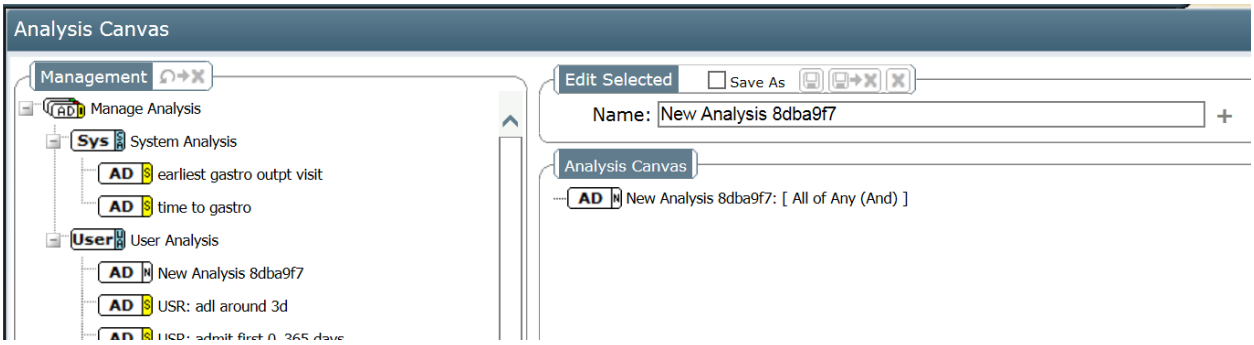
You see the Advanced Method with the **Analysis Definition Flag** replacing the End flag:



You now must build an Analysis Definition.

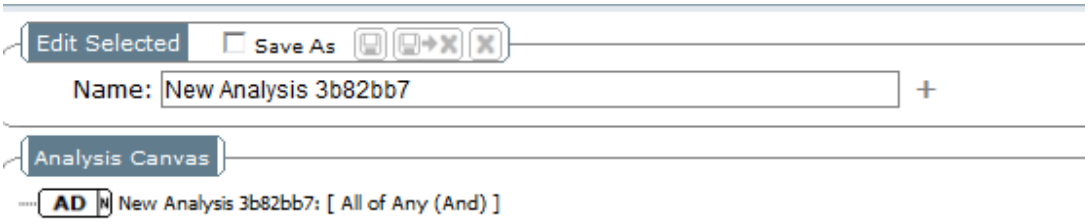
To build, left click on the three dotted button.

Click on the builder button and you will find yourself in the Analysis Canvas:

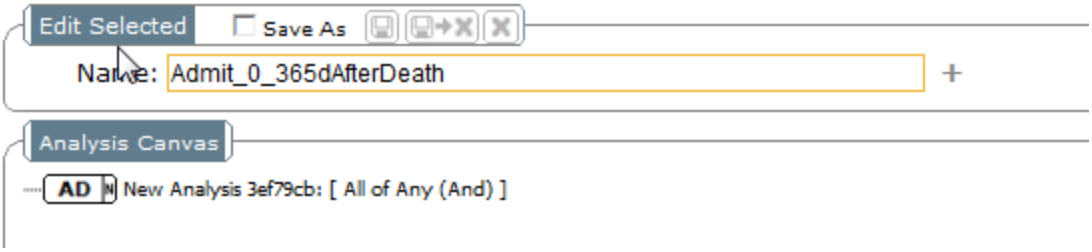


Our goal is to build an **Analysis Definition** that tells Study designer to follow elapsed time from 0 to 365 days after the index event of the cohort member.

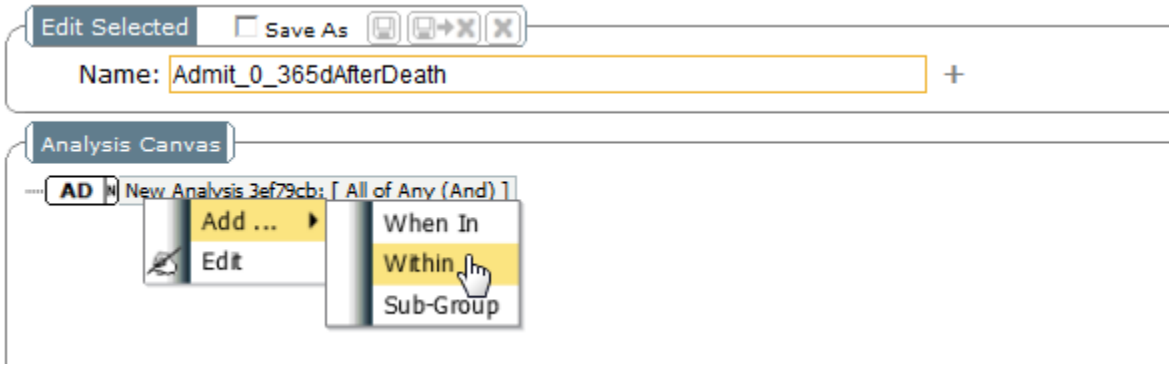
Until the first hospital admission with a disposition of death.



Type the name “Admit_0_365dAfterDeath” to your analysis definition.

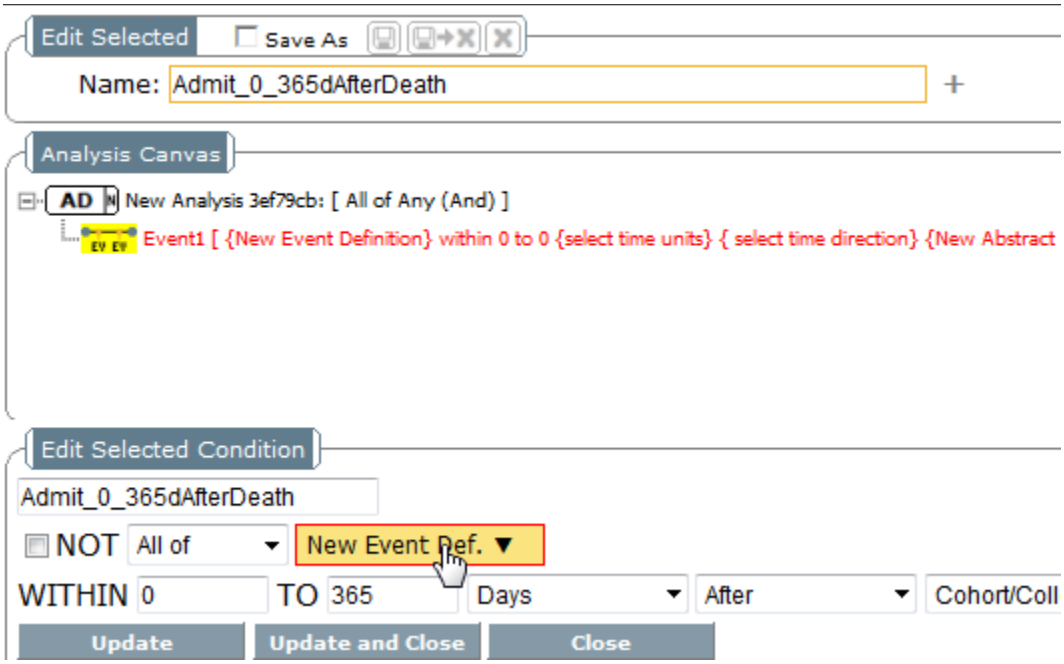


Right click on the Index Event line and add a Within condition

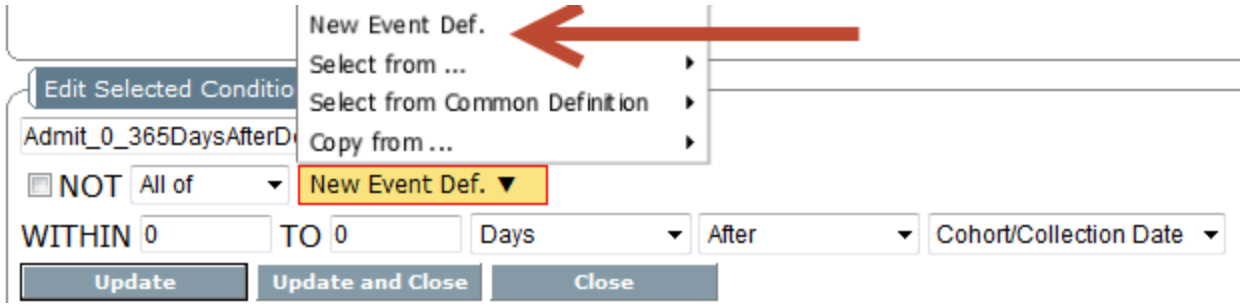


a. Name you event definition “Admit_0_365dAfterDeath”
b. Choose All of
c. Choose time 0 to 365 Days
d. Build death into an inpatient admission by using an attribute of the admission, disposition = expired by doing the following:

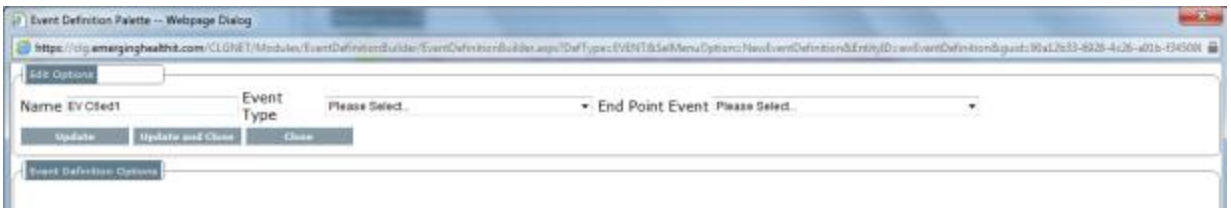
Highlight New Event Definition and left click



Select New Event Def. from the drop down menu.



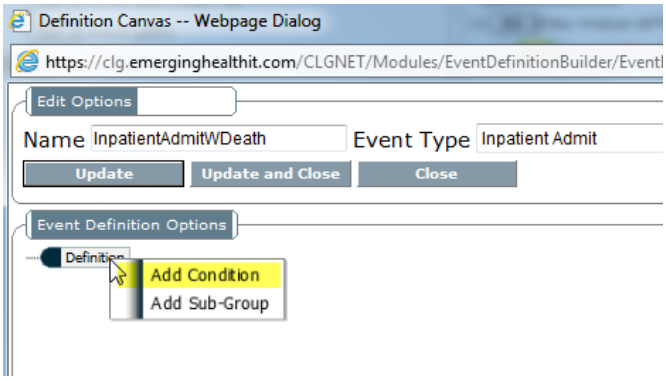
The new Event Definition Palette will open.



Name the event definition “InpatientAdmitWDeath” and choose Inpatient Admit as the event type

Now define your event attribute.

Right click on Definition and add a condition

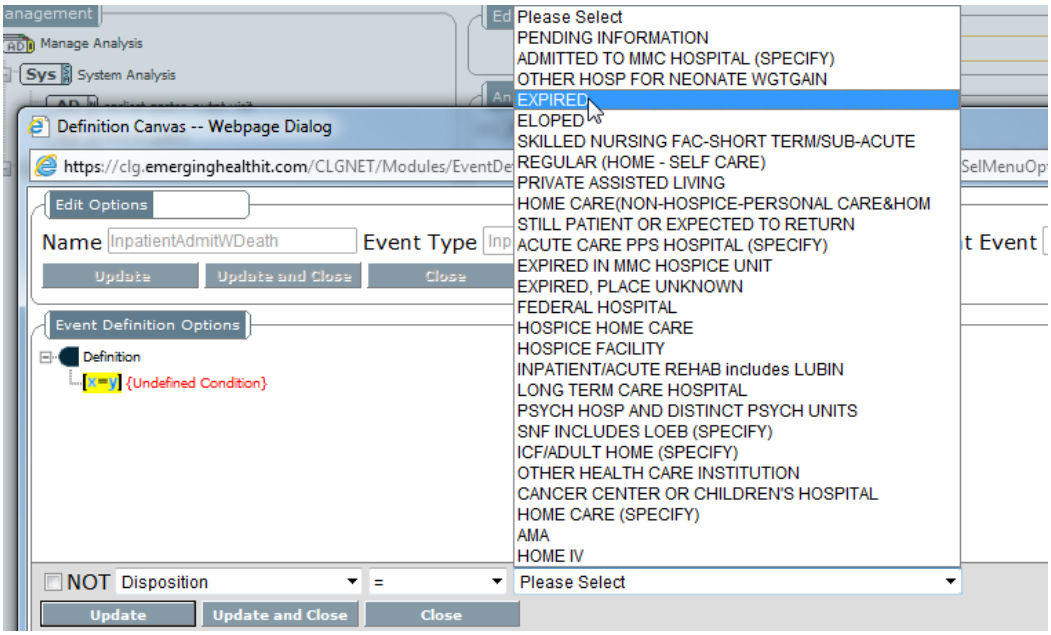


A new condition appears in the GUI editor on the bottom of the screen

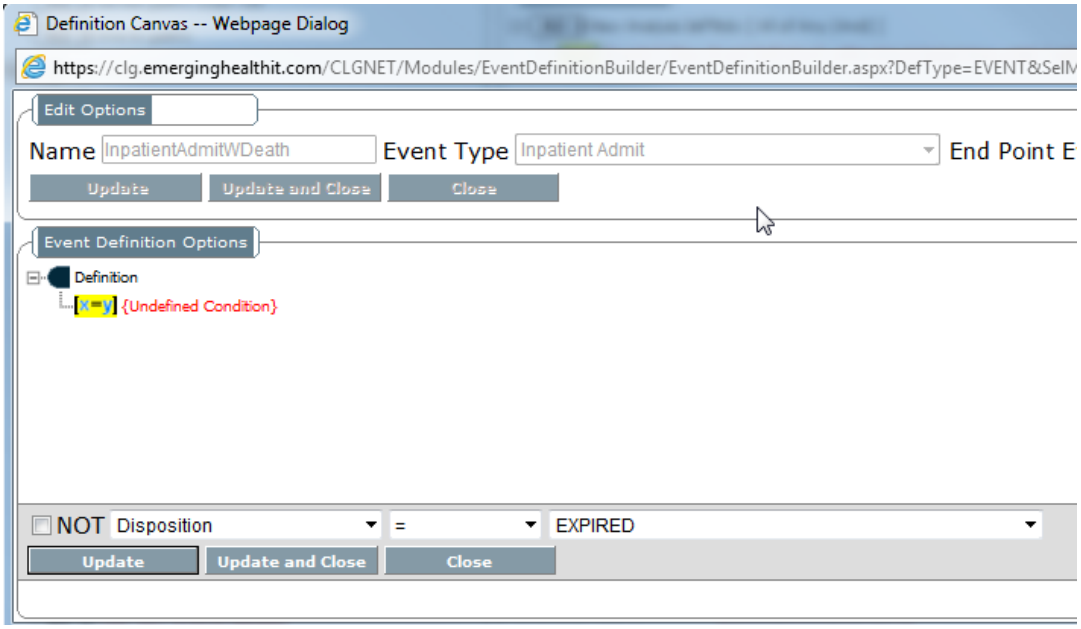
From the drop down menu, select **Disposition** from the list of inpatient admission attributes.

Another drop down will appear to the right of disposition. You can select “=” or create a set.

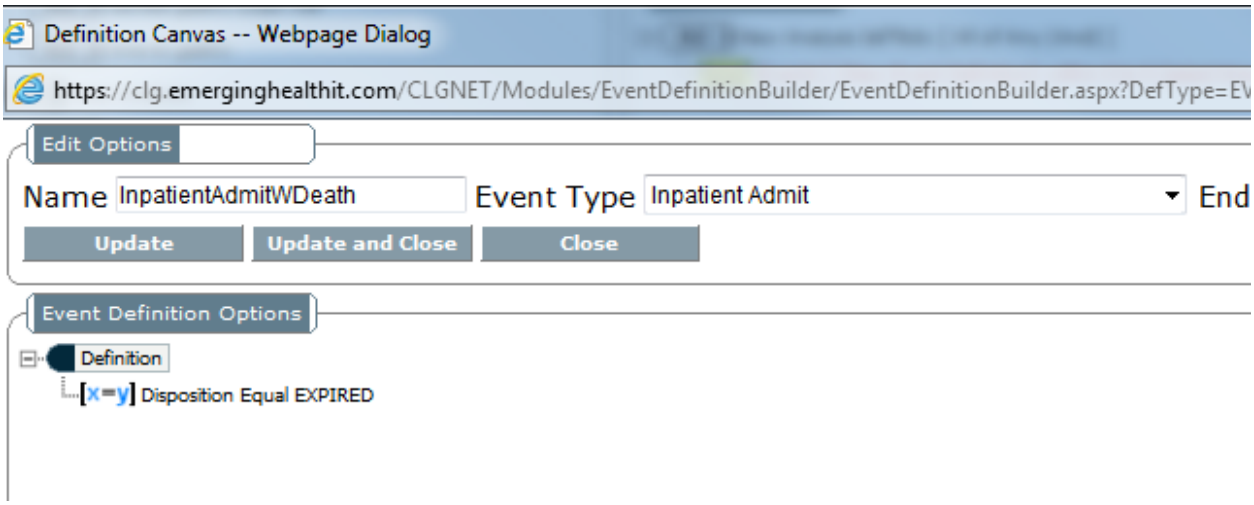
Select “=”. Then select expired from the last drop down on the GUI editor.



This results in:

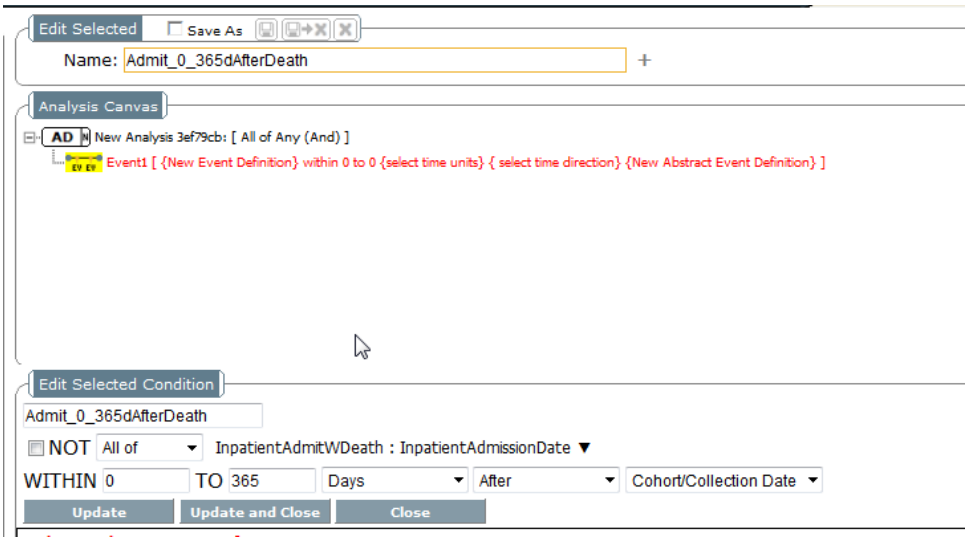


Update and close to populate the definition condition.

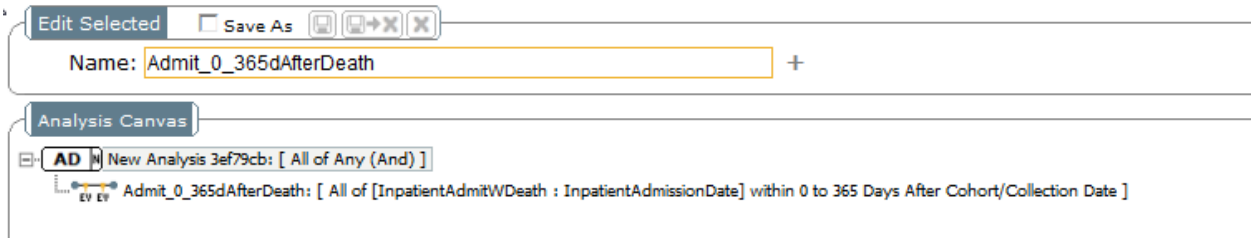


Update and close again to populate the event definition.

In the GUI, the entry box “after” points to the cohort/collection date


Edit Selected
Save As
Name: Admit_0_365dAfterDeath
Analysis Canvas
AD N New Analysis 3ef79cb: [All of Any (And)]
Event1 [{New Event Definition} within 0 to 0 {select time units} { select time direction} {New Abstract Event Definition}]
Edit Selected Condition
Admit_0_365dAfterDeath
NOT All of InpatientAdmitWDeath : InpatientAdmissionDate
WITHIN 0 TO 365 Days After Cohort/Collection Date
Update
Update and Close
Close

Update and Close.


Edit Selected
Save As
Name: Admit_0_365dAfterDeath
Analysis Canvas
AD N New Analysis 3ef79cb: [All of Any (And)]
Admit_0_365dAfterDeath: [All of [InpatientAdmitWDeath : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]

The index event line still needs to be edited.

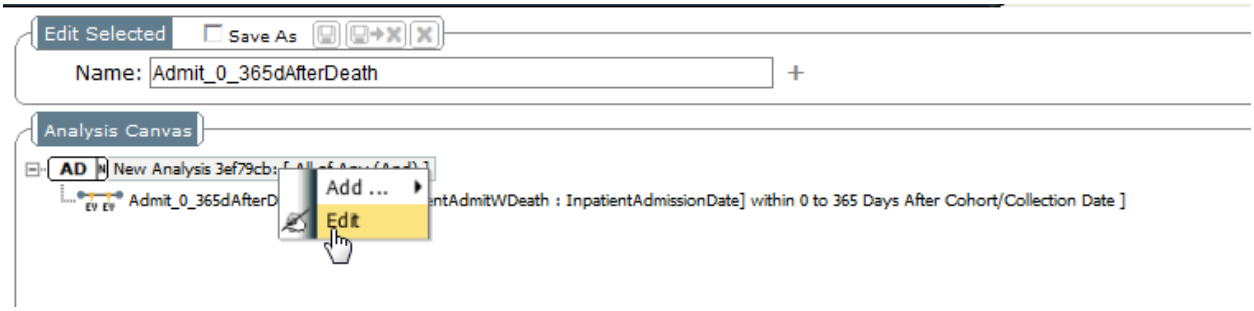
Remember that we are building this Analysis Definition for the purpose of using it in a Time to Outcome study.

A Time to Outcome analysis will only recognize a singularity (“Earliest of” or “Latest of”).

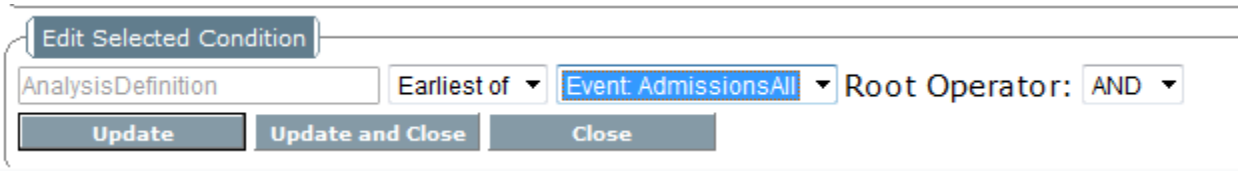
The default setting is a multiplicity (All of).

Change the Index Event line to “Earliest of” the condition: Admit_0_365dAfterDeat h.

Right click the Index Event line, hover over Edit and left click.



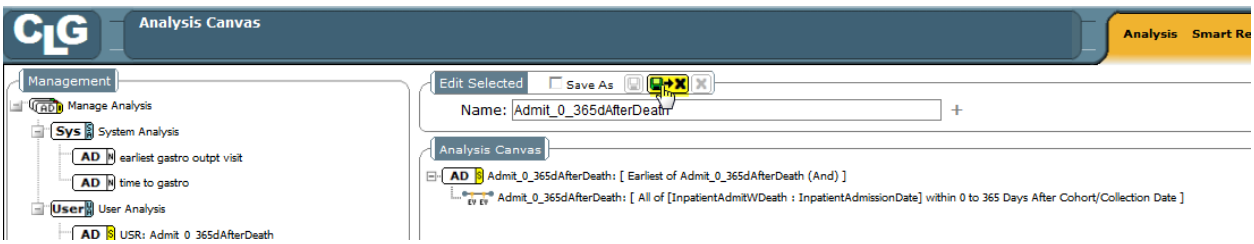
From the drop down menus, choose “Earliest of” and then choose your event condition line “AdmissionsAll”.



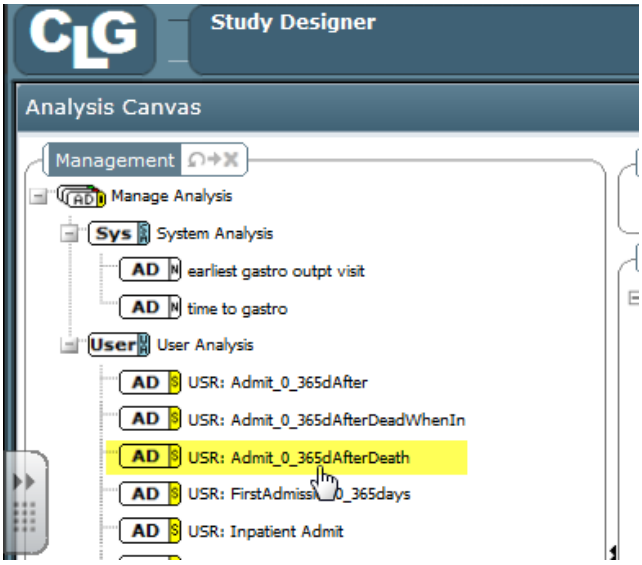
Update and close.

Edit Selected
Save As
Name: Admit_0_365dAfterDeath
Analysis Canvas
AD
: [Earliest of Admit_0_365dAfterDeath (And)]
Admit_0_365dAfterDeath: [All of [InpatientAdmitWDeath : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]

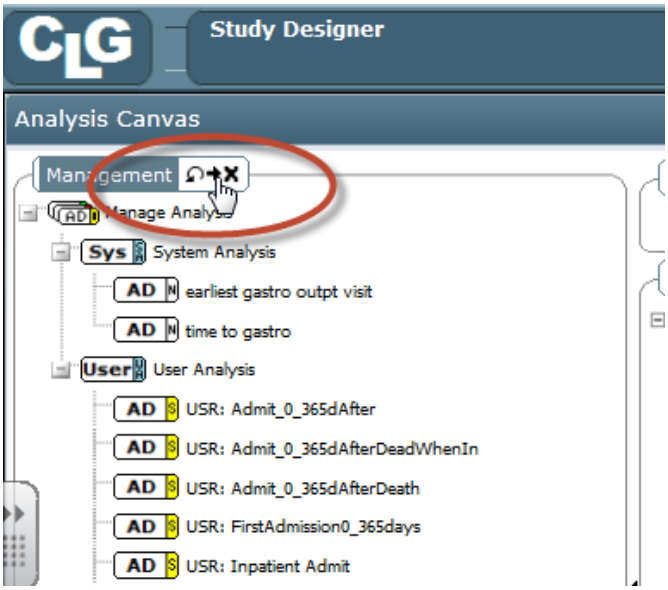
Save and close.



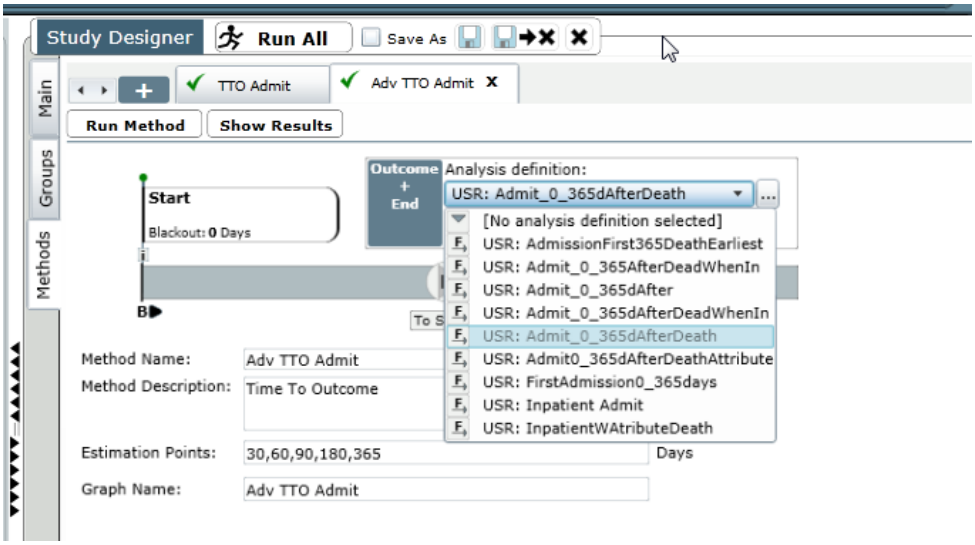
Your newly build Analysis Definition will appear in the management pane.



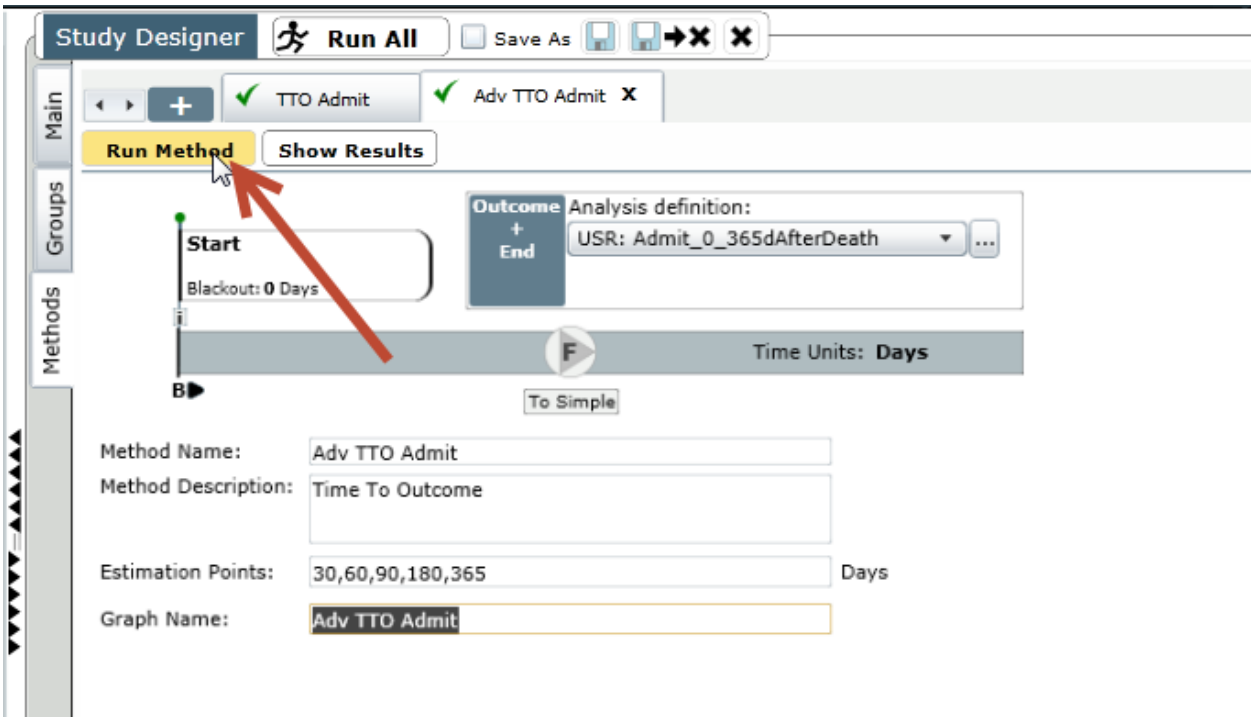
Left click the refresh and close button and you will be directed back to Study Designer.



Find the new Analysis Definition from the drop down menu



Choose the Analysis Definition “Admit_0_365dAfterDeath” and Run Method:



Save your study.

Next, we will build an AD with death as an event that occurs “during” the durational event of the admission. Approach #2.

You will be building an AD with two lines.

The first line will look for an admission within 0 to 365 days of the cohort collection.

This admission will not have a disposition=expired. We will not require any disposition at all.

The second line will have an event death “when in” the event of the first condition line on the Analysis Canvas.

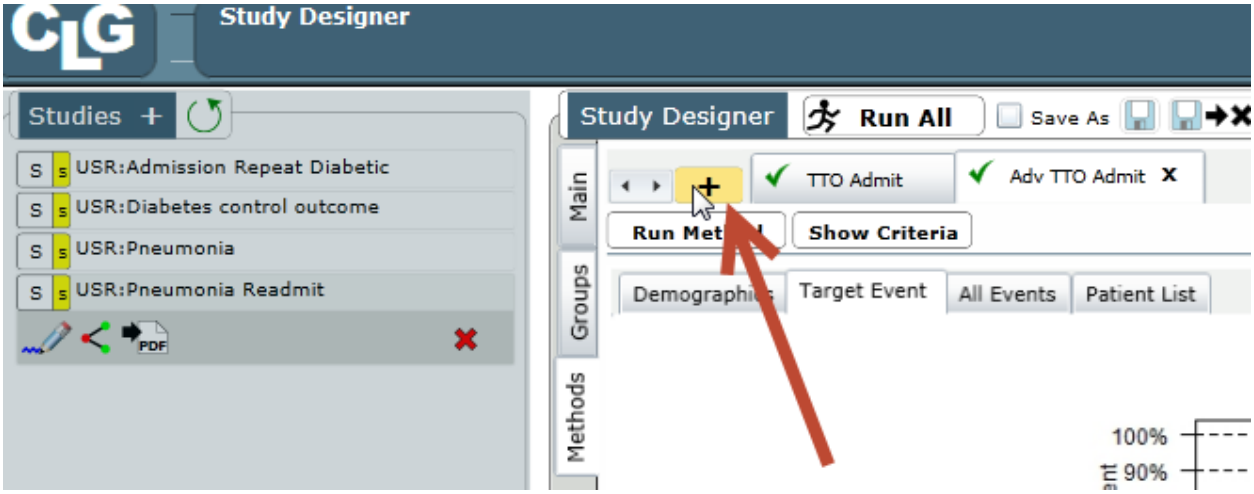
The “when in condition line” requires a death during the first admission following the cohort’s index date.

Condition Line one: Earliest Admission within 0 to 365 days of the cohort collection

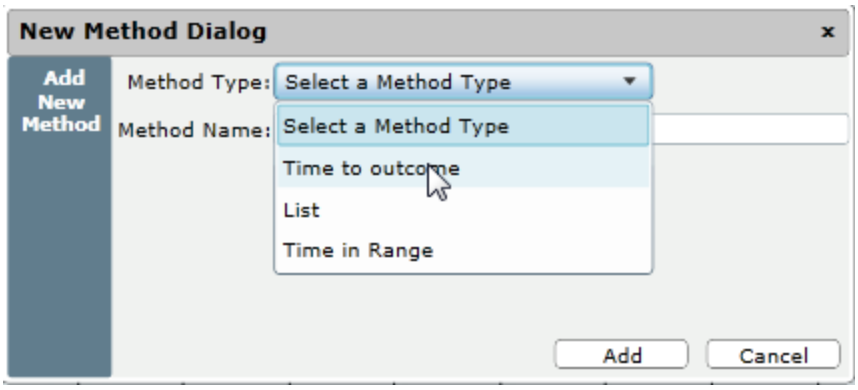
And

Condition Line 2: Earliest Death In House or Social Security When In (during) the duration of the admission

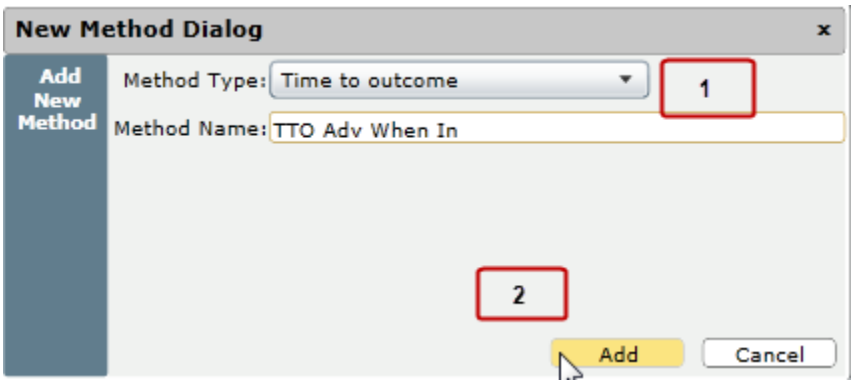
Add a new method in Study Designer



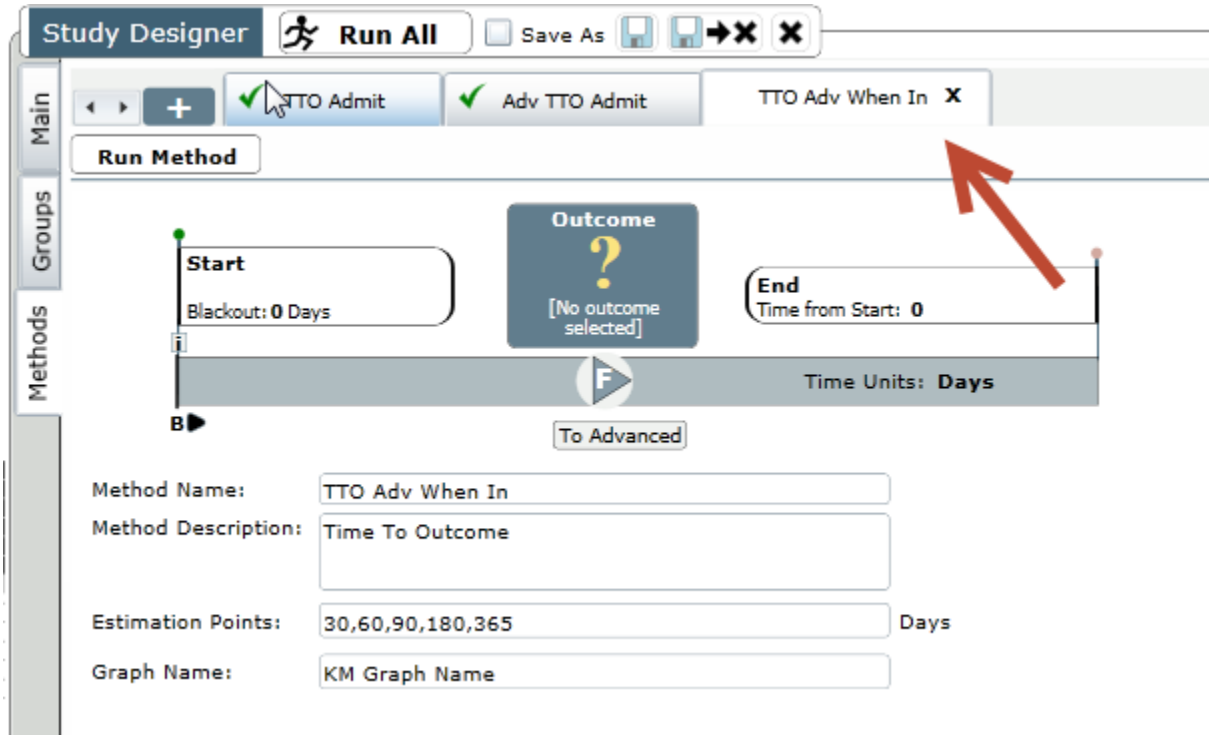
Choose a Time to Outcome method.



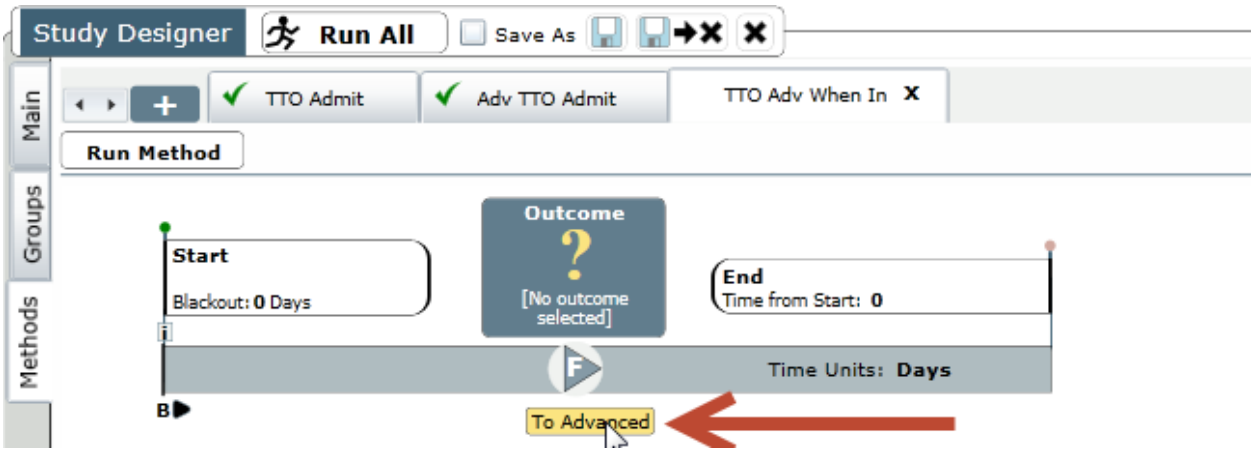
1. Name the new Method “TTO Adv When In”
2. Click Add



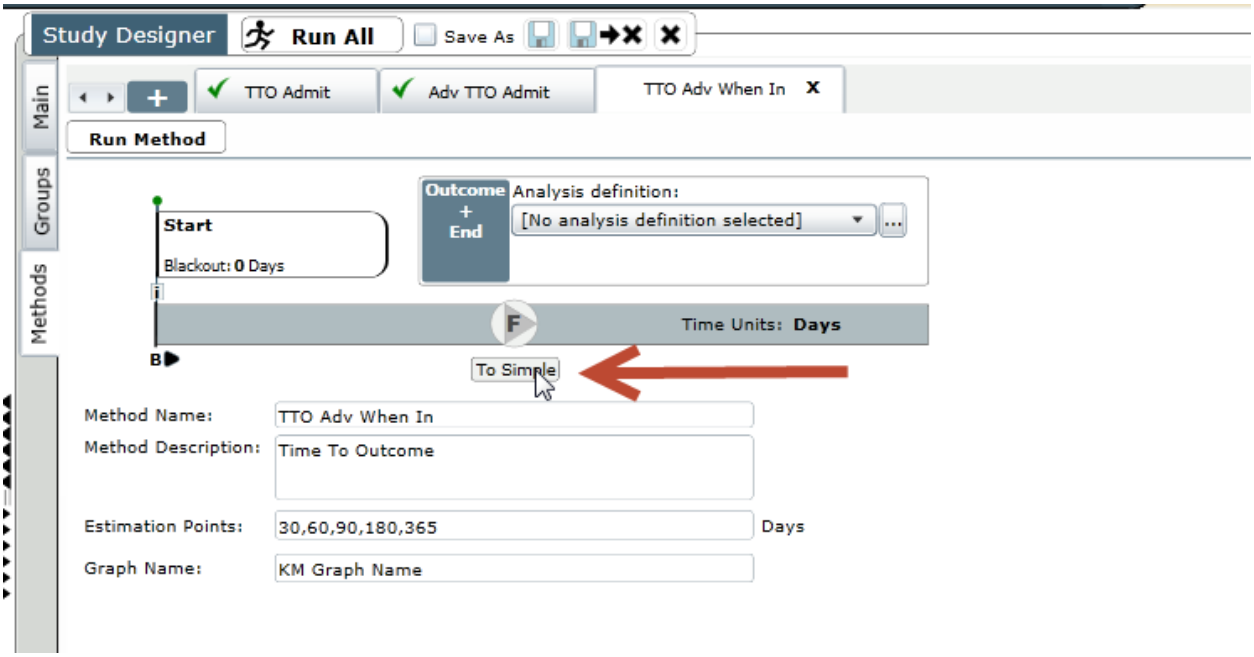
A new method tab appears on the top of the canvas, adjacent to the previous methods that you’ve already built



We need to move to advanced mode from the simple mode. Hover over “To Advanced” and left click.

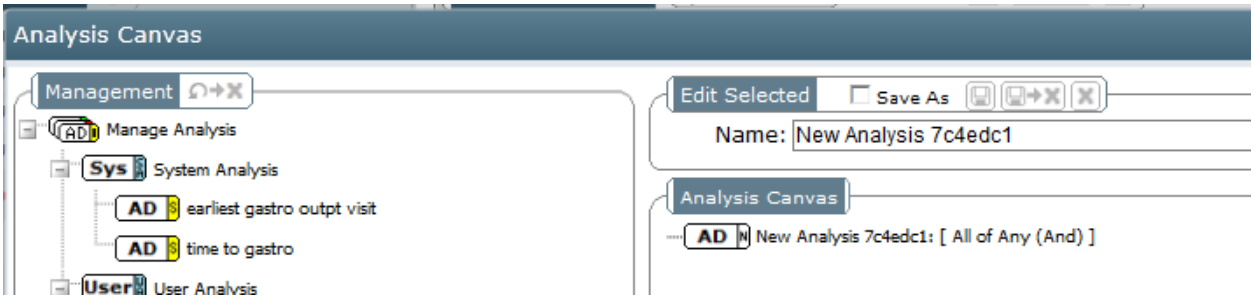


The Racetrack Metaphor changes from Simple to Advanced mode.



We will use the triple dotted button to move into the Analysis Canvas and edit our Analysis Definition.

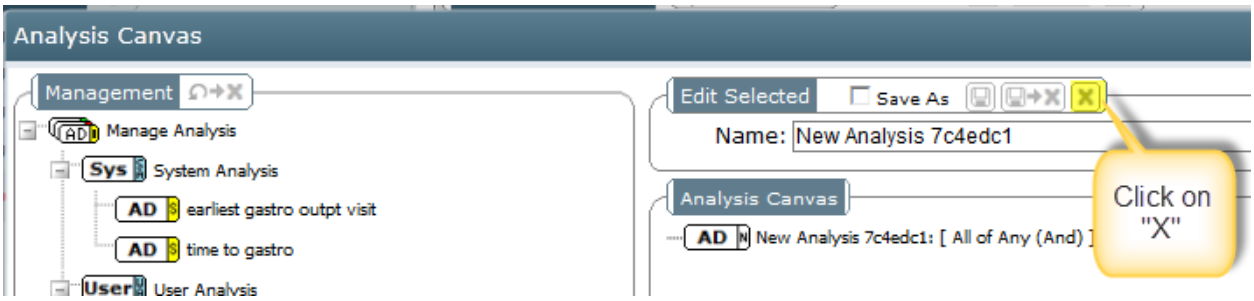
This opens the Analysis Canvas.



Our plan is to modify a preexisting Analysis Definition.

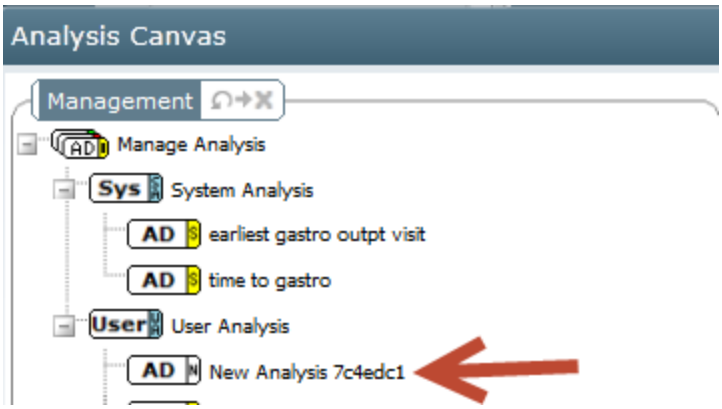
Therefore, we have to exit the right-hand side and go to the management pane.

Click on Exit.



Now for some housekeeping.

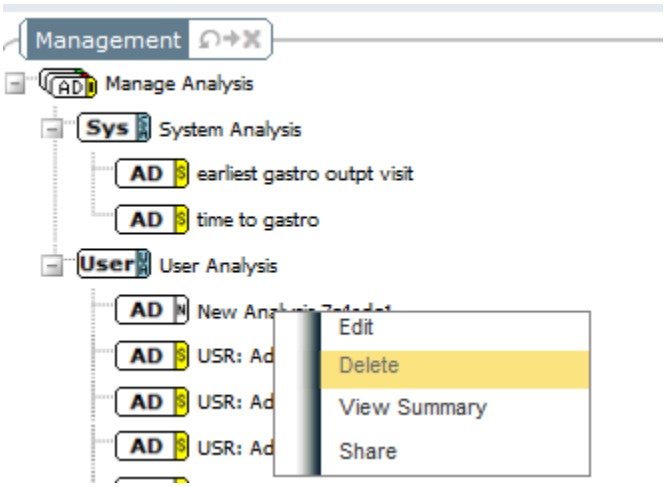
In the management pane, look for the incomplete Analysis Definition.



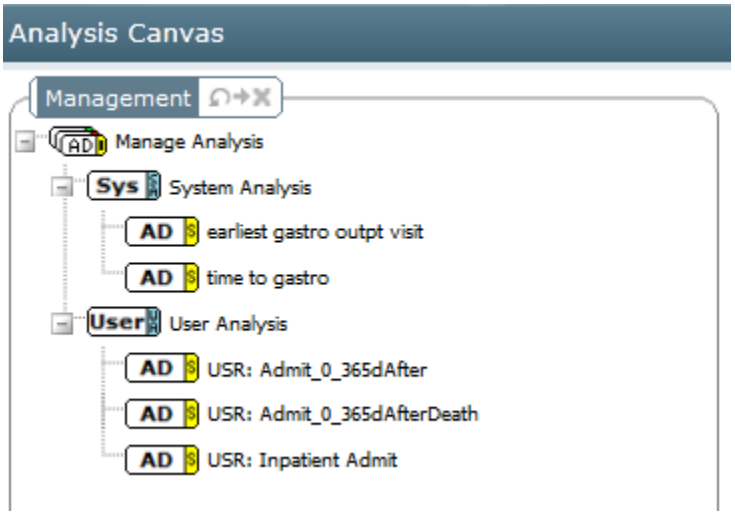
As you can see, the AD called “New Analysis 7c4edc1” has a right white stripe, not green stripe.

The lack of green means that it is an incomplete AD.

Now delete this AD.

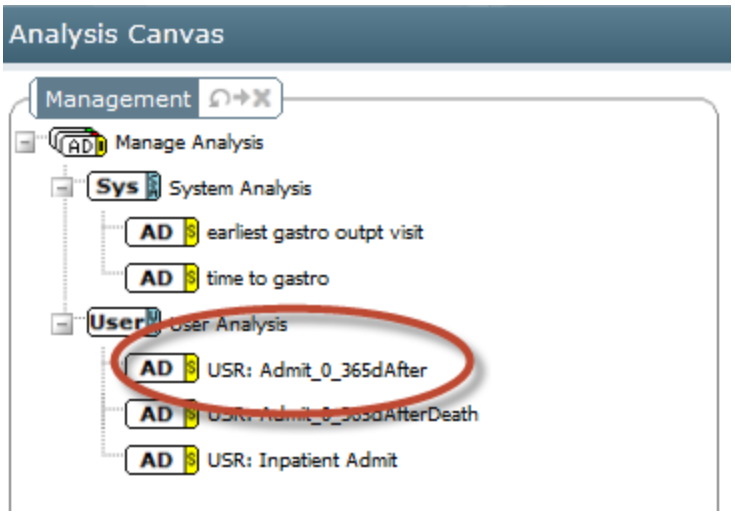


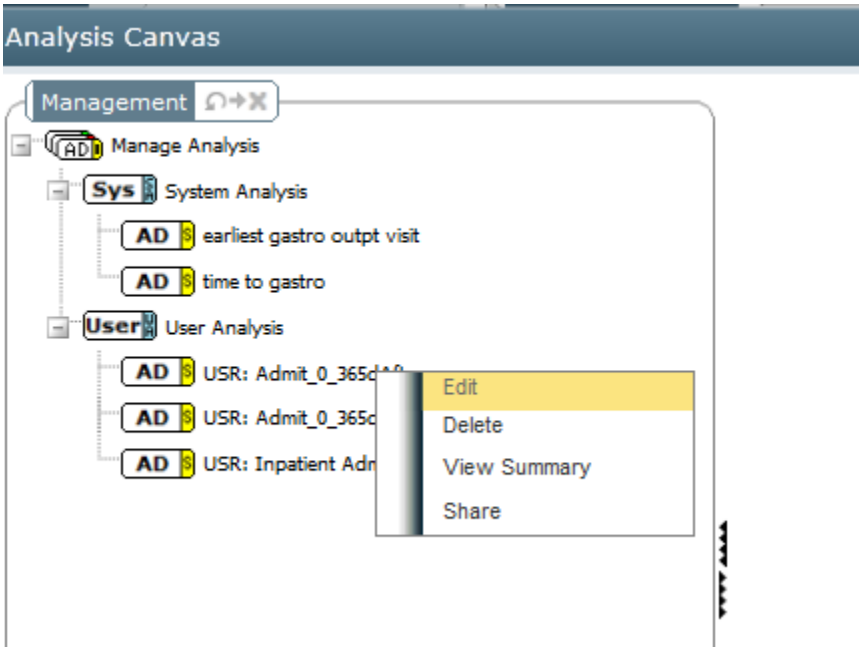
Without this AD, the management pane looks like:



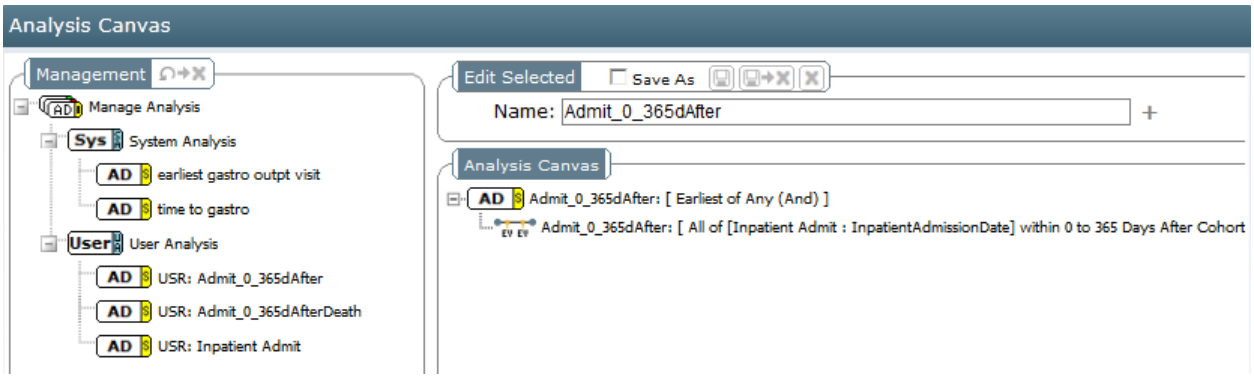
We are now going to take advantage of work we've already done by modifying a previously built AD, and saving it with a new name so we end up with both the original AD and a newly named AD.

Hover over the "Admit_0_365dAfter" and right click and edit. This is the original AD you built a while back that did not have death as an attribute of the admission.

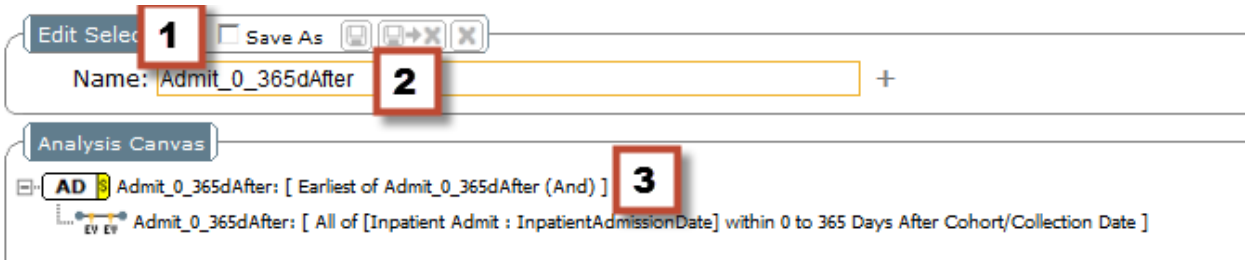




The following image appears:



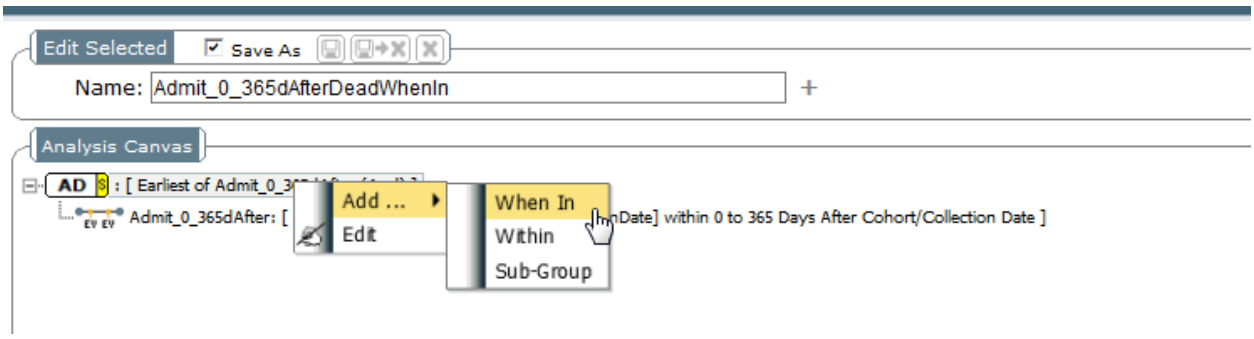
Now, we will concentrate on the analysis canvas.



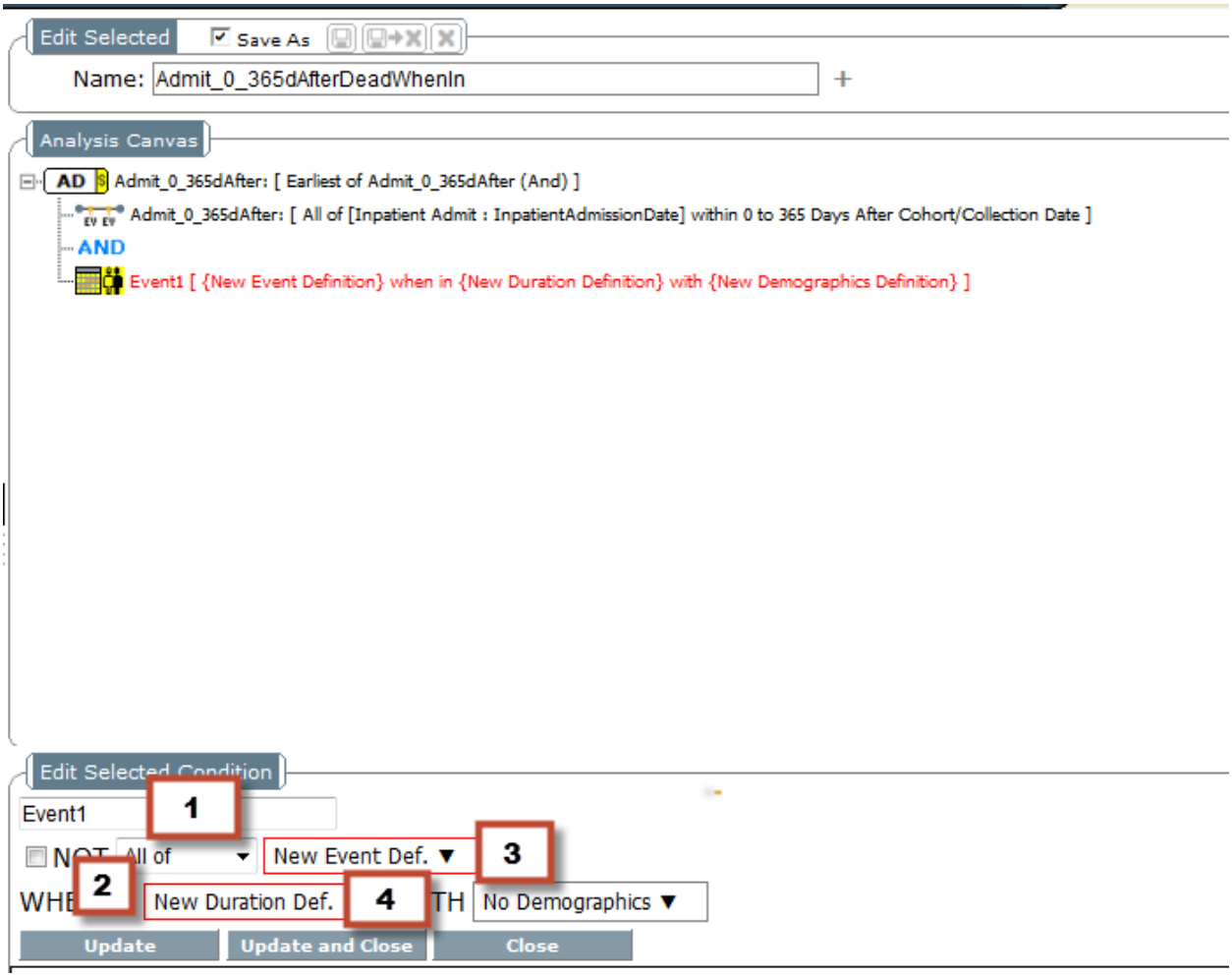
1- Check off save as (so you can create a newly named AD without overwriting the original)

2- Rename the AD as: Admit_0_365dAfterDeadWhenIn

3- Right click on the index line to show drop down menu and choose “When In ”.



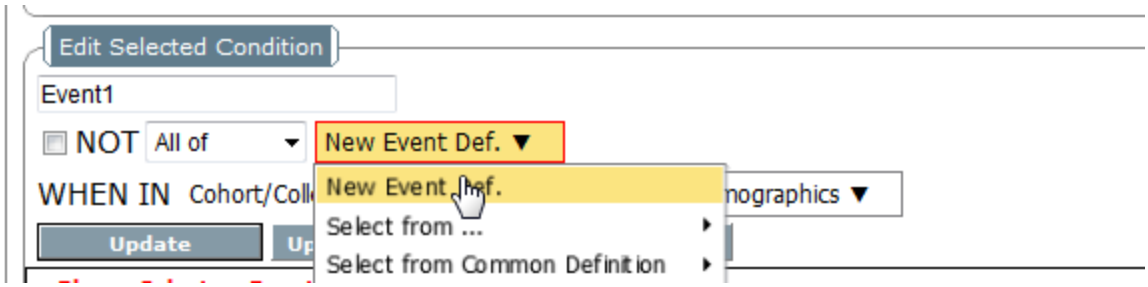
This creates a new “When In” condition line and opens a GUI editor below.

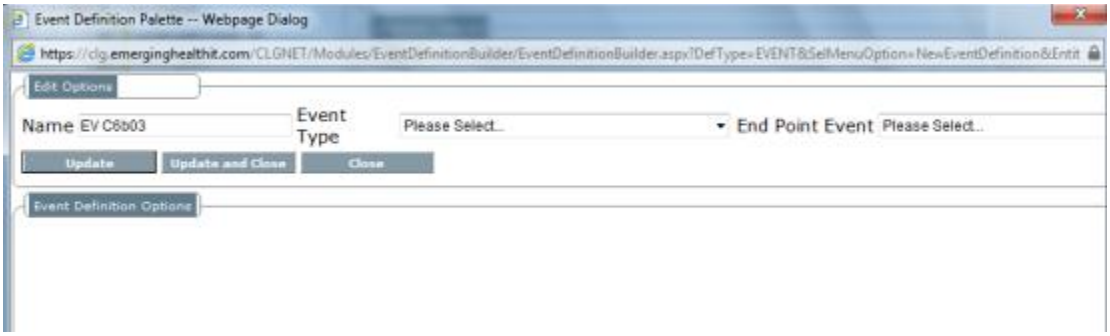


1-Put in a new name: Death in House or in Social security

2- Choose All of: A bug in the program requires death to always be addressed with “All of”, and not earliest

3-Left click on downward arrow New Event Definition to create a new event



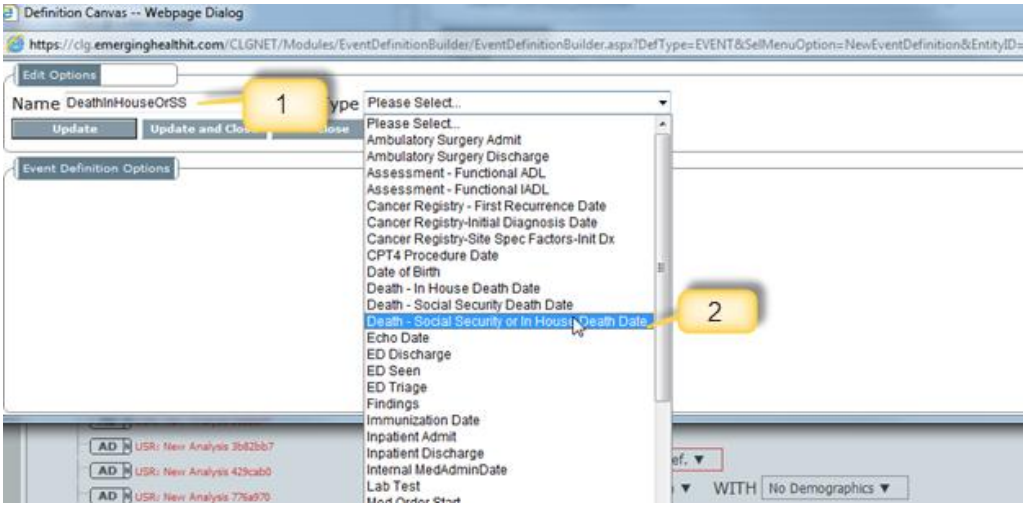


We want to find the event Death.

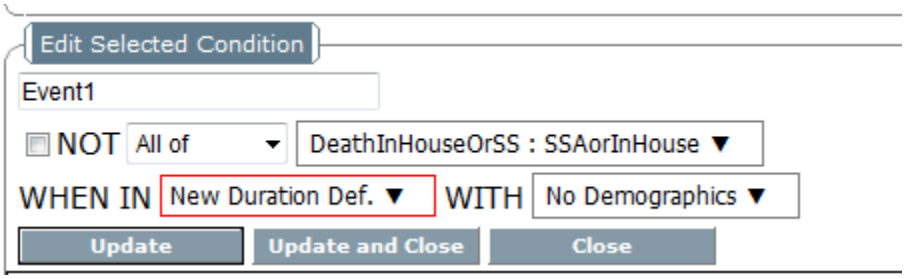
We will use Death in House or Social Security.

1. Rename your event type to be “DeathinHouseorSS”

2. Find the event type from the drop down menu

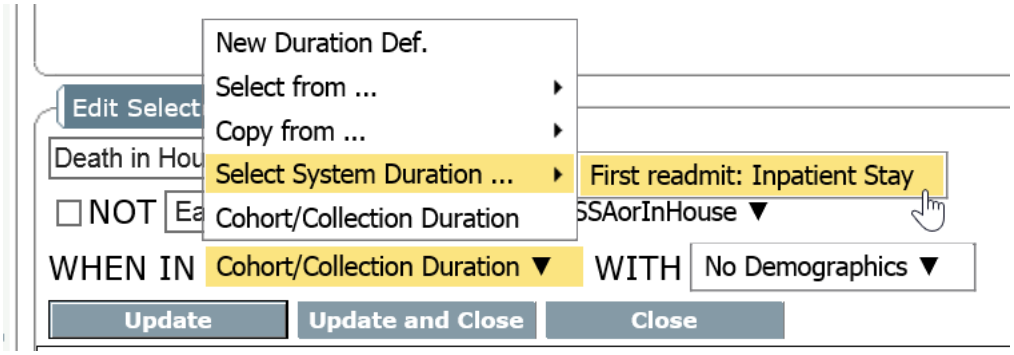


Update and Close.



Now we are going to choose a New Duration Definition.

Let's look at our options.



New duration - would create a new calendaric interval.

Select from - would select from the calendaric interal.

Copy from - would copy the calendaric interval.

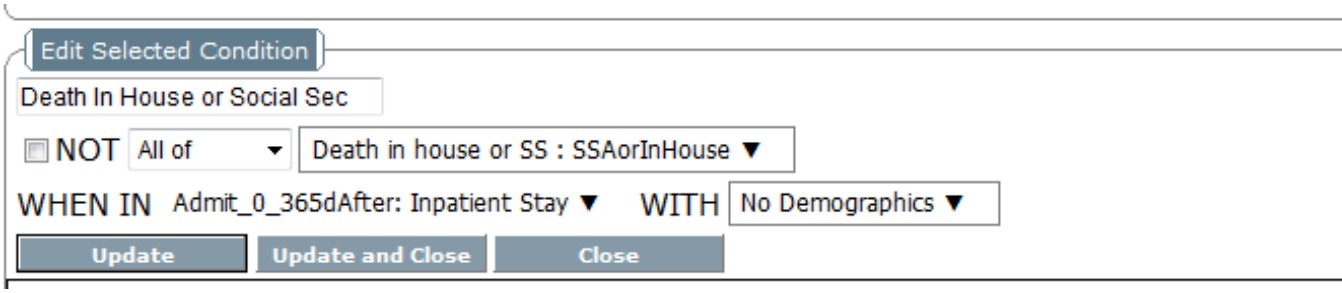
Select System Duration – We want our death event to occur during the duration of the hospitalization in condition line one. We therefore choose Select System Duration and accept Looking Glasses offer of "First readmit: Inpatient Stay"

Cohort/Collection Duration - would point outside the analysis canvas to the event used to build the cohort (cohort member's index event). Since we want the death to occur in the downstream admission, we avoid this option.

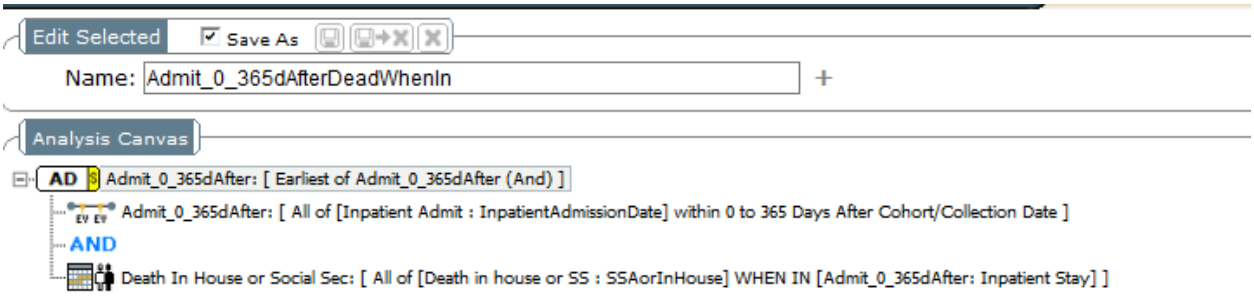
For the duration, you choose "Select System Duration" from the analysis canvas. CLG offers the only condition line on the canvas with a durational event that you can select.

> Note: "Select System Duration" is different from the last choice in the drop down "cohort/collection duration" which reaches off the analysis canvas and points to the cohort member's index event.
>
> Imagine if you had chosen to point to the cohort member's original event, you would be requiring that the patient died during the first pneumonia hospitalization which is impossible because you are assuming the existence of a subsequent admission. And, we do not readmit dead people.

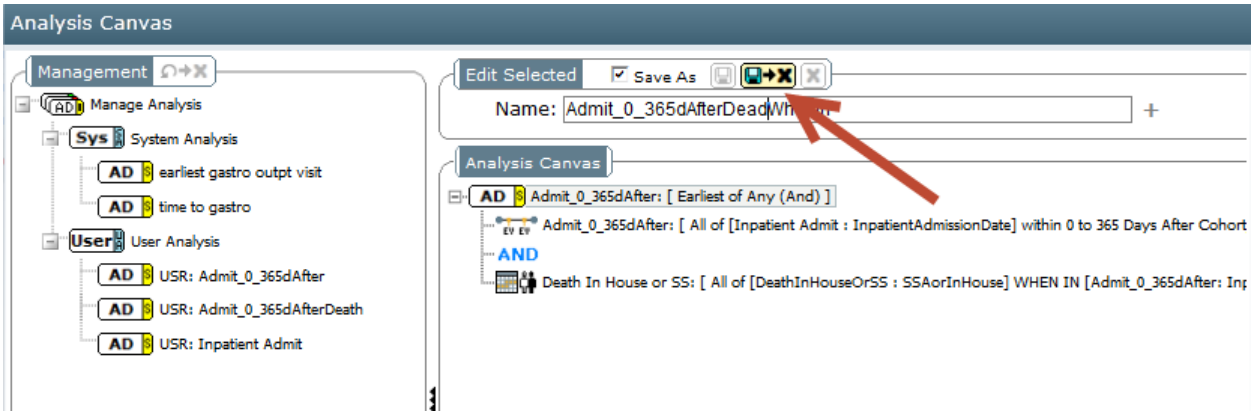
The Gui editor now looks like:



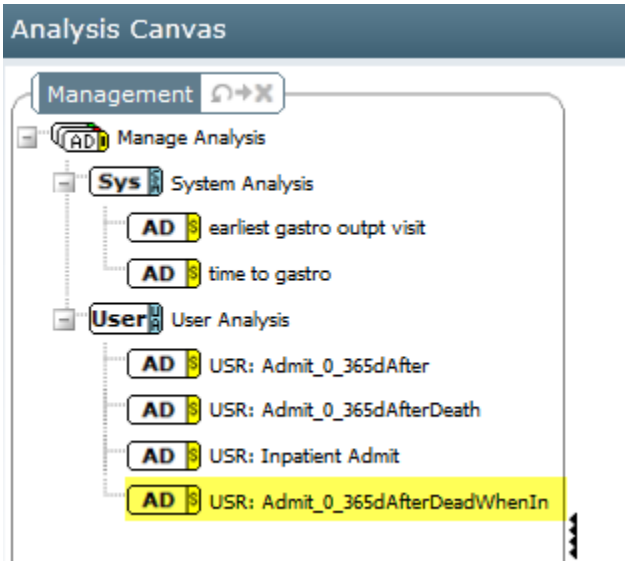
Update and close.


Edit Selected
Save As
Name:
Admit_0_365dAfterDeadWhenIn
Analysis Canvas
AD
Admit_0_365dAfter: [Earliest of Admit_0_365dAfter (And)]
Admit_0_365dAfter: [All of [Inpatient Admit : InpatientAdmissionDate] within 0 to 365 Days After Cohort/Collection Date]
AND
Death In House or Social Sec: [All of [Death in house or SS : SSAorInHouse] WHEN IN [Admit_0_365dAfter: Inpatient Stay]]

Save and close.

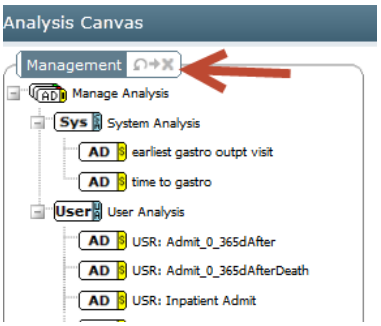


You now see the new AD in the Analysis Canvas Management Pane

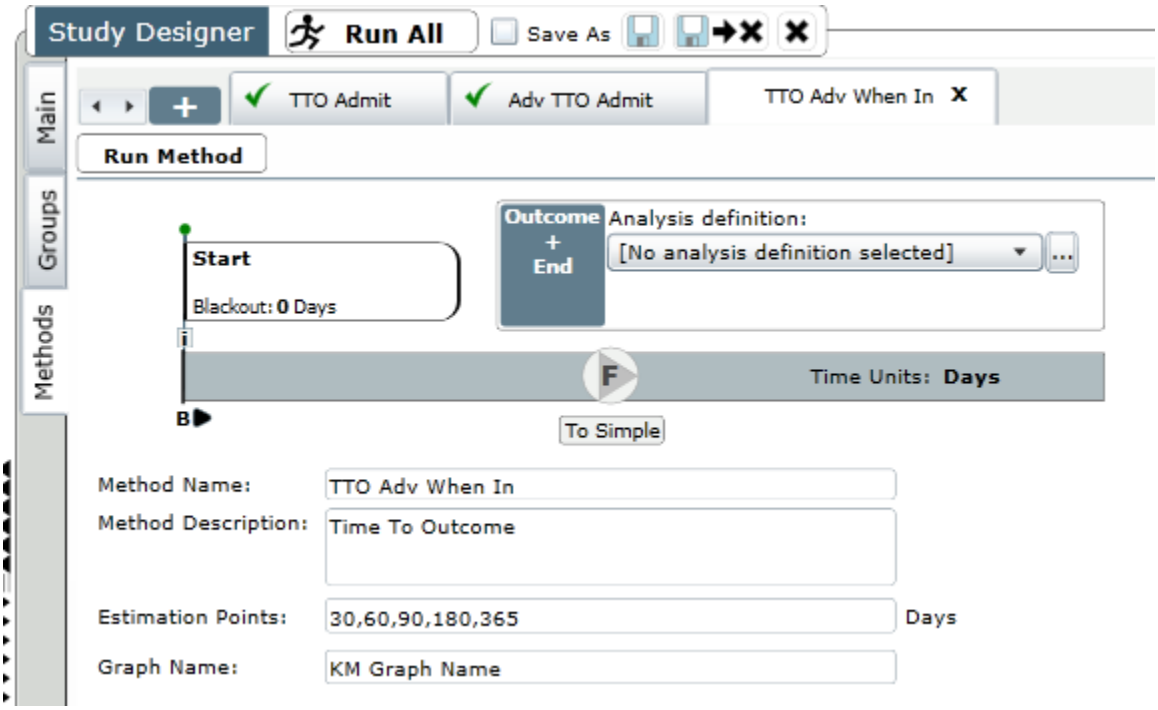


Now we want to use our AD in our Time to Outcome Analysis.

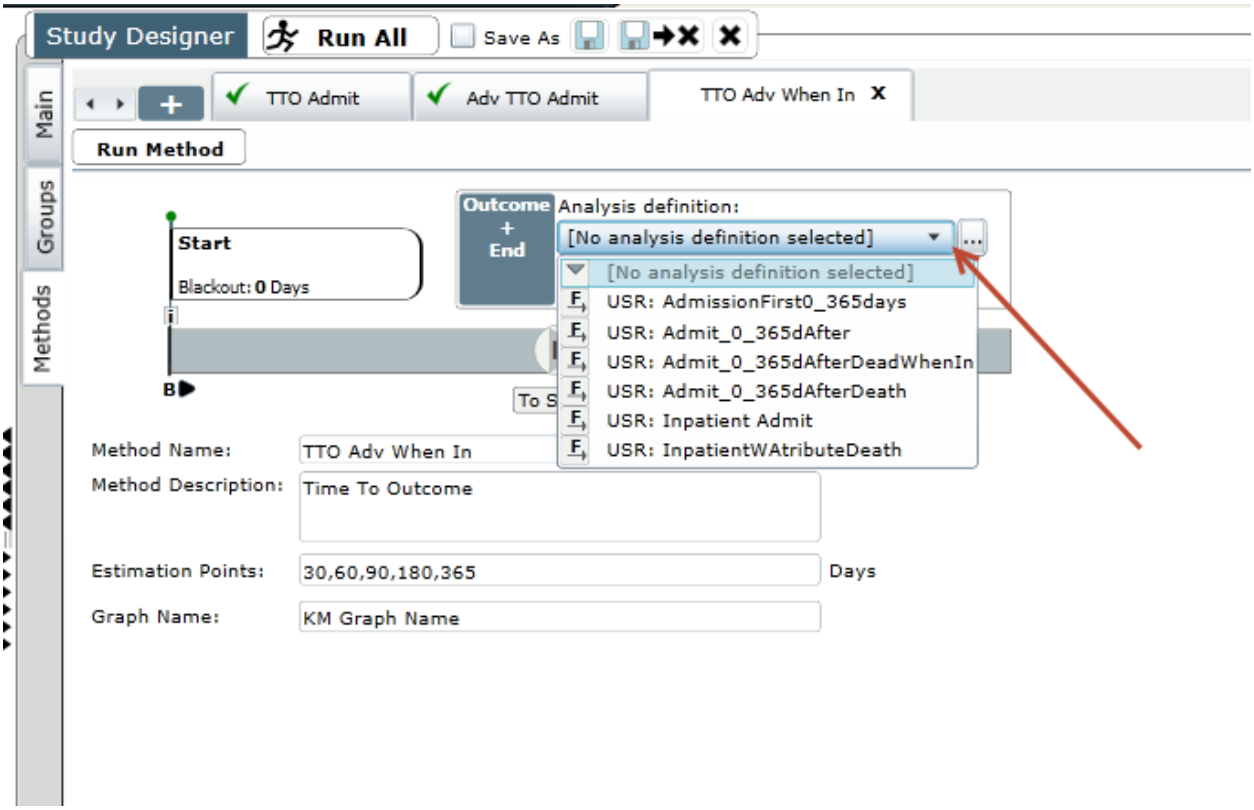
Return to Study Designer by left clicking management pane's close button.



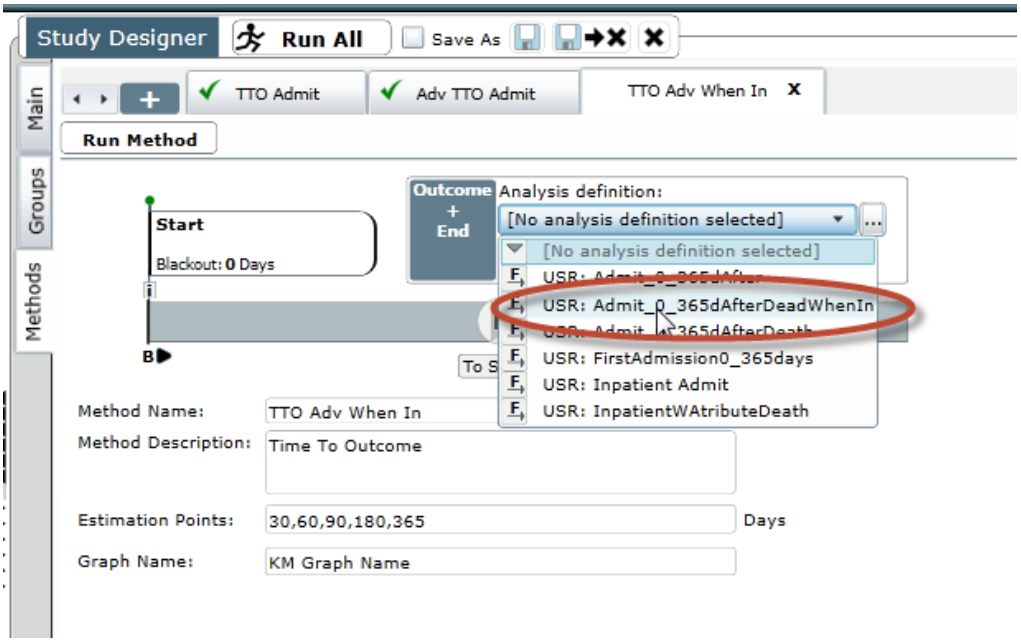
Now we find ourselves back in Study Designer Advanced Mode.



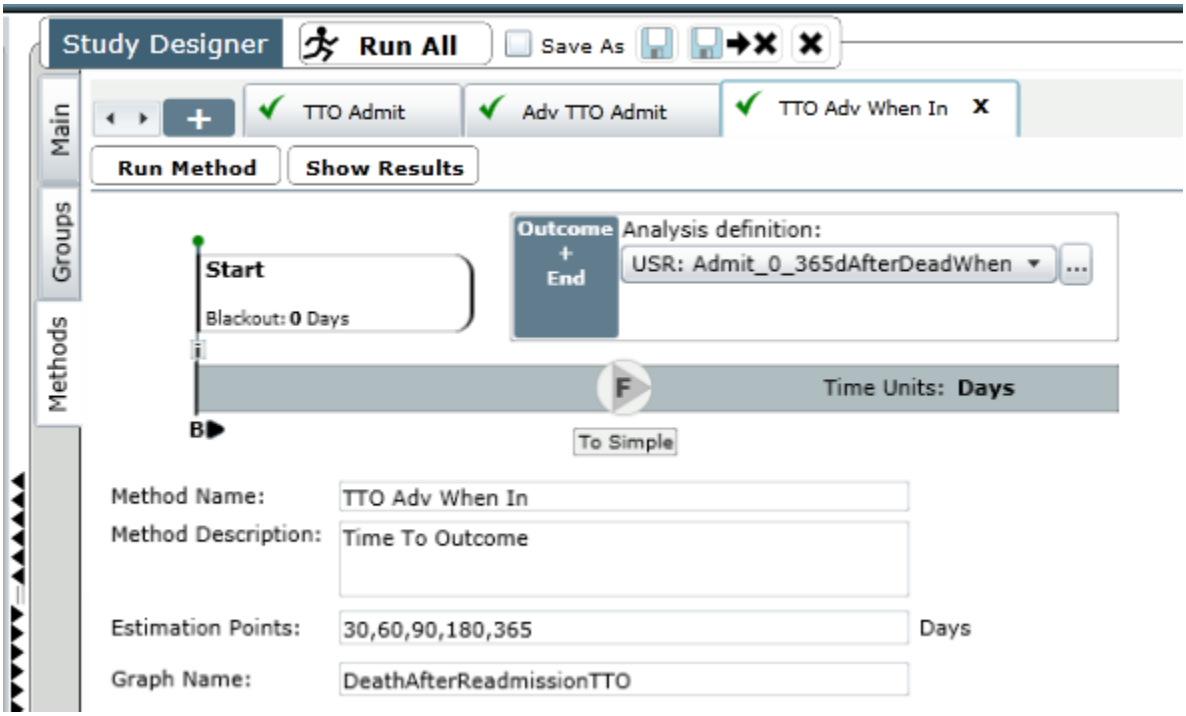
Now we want to select the Analysis Definition we just built from the dropdown menu by left clicking on the downward arrow.



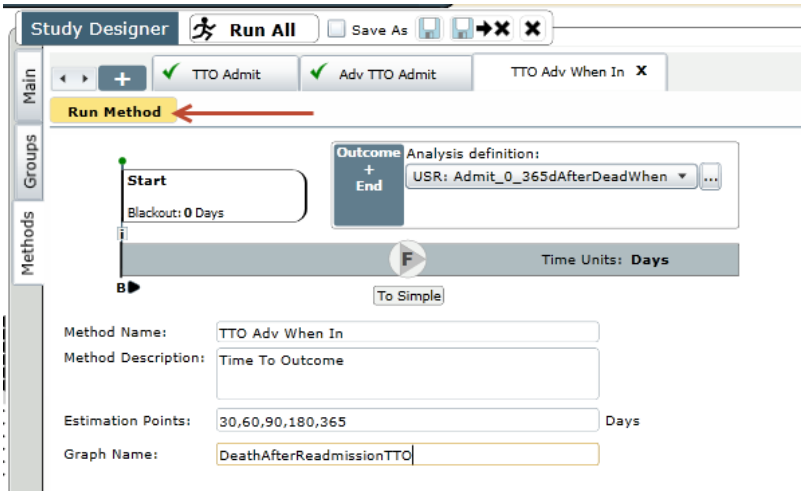
Now select “Usr: Admit_0_365dAfterDeadWhenIn”.



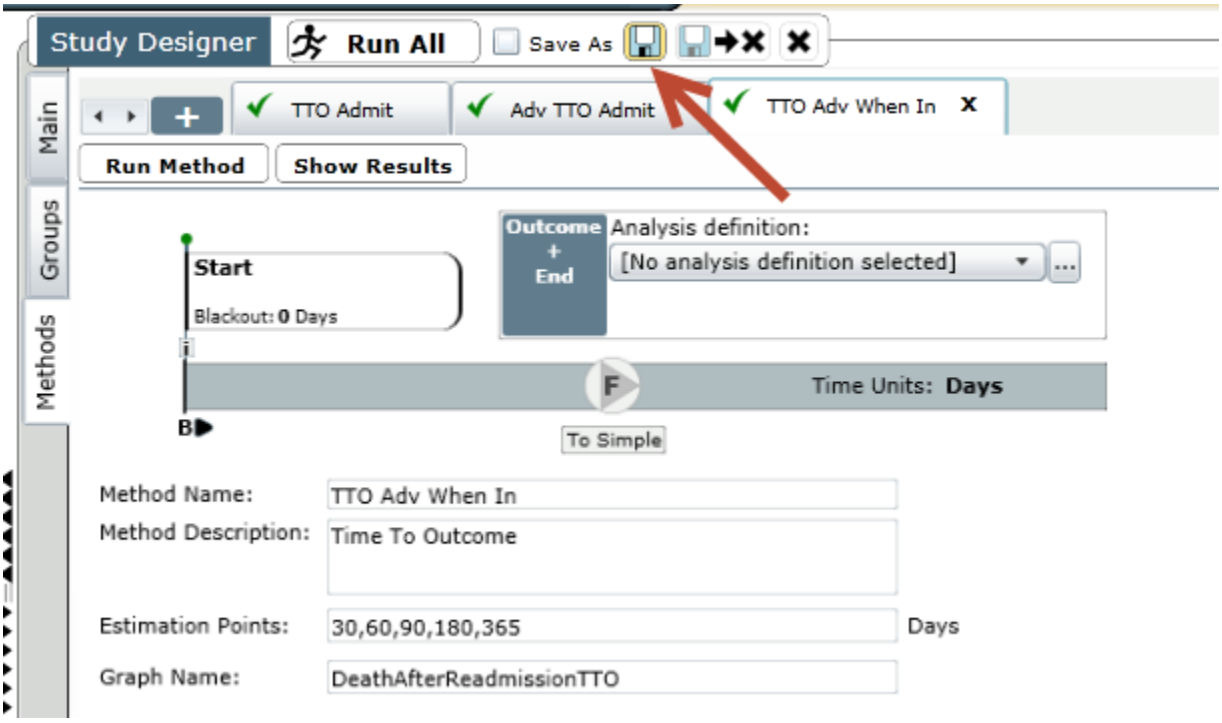
Name the Graph: “DeathAfterReadmissionTTO”



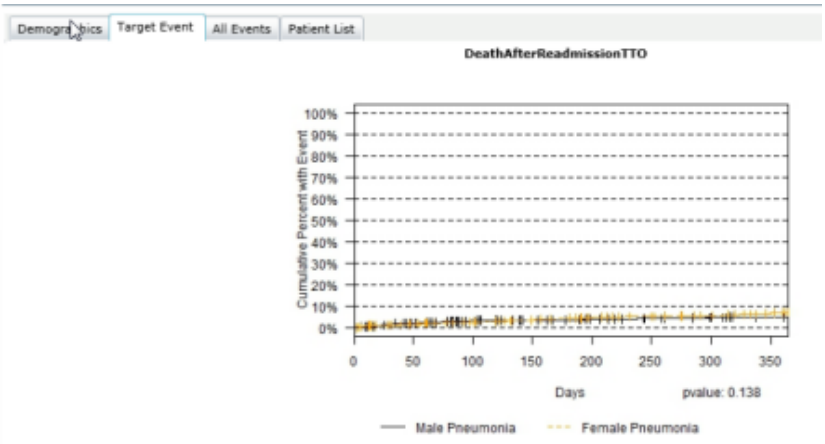
Run the Method.

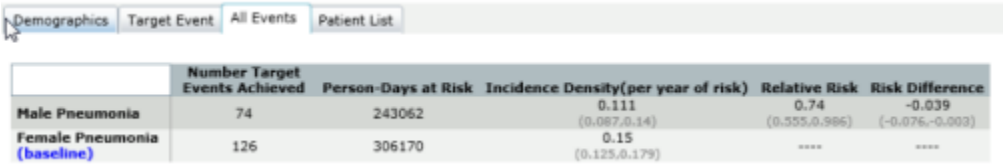


Remember to Save once the method has run.



Review the results from the demographics, target events, and all events tabs.





	Number Target Events Achieved	Person-Days at Risk	Incidence Density(per year of risk)	Relative Risk	Risk Difference
Male Pneumonia	74	243062	0.111 (0.087,0.14)	0.74 (0.555,0.986)	-0.039 (-0.076,-0.003)
Female Pneumonia (baseline)	126	306170	0.15 (0.125,0.179)	----	----

Summary – Utility of Advanced Method TTO

1. You can have latest event or earliest event while the simple method permits only the earliest event
2. You are able to have complex outcomes with multiple condition lines on the analysis definition while in the simple method you can have only one event as an outcome.

3. Tutorial 19: Meaning of Earliest vs. all (ppt 6)
   https://www.youtube.com/watch?v=wOvNybshJpc
4. Tutorial 20: A Reminder in Time (ppt 7)
   https://www.youtube.com/watch?v=s77M_mBdNnc
5. Tutorial 21: A conversation between objects (ppt8)
   https://www.youtube.com/watch?v=lf4ZmzVrmSE

List Method Looking only at the attributes of the cohort

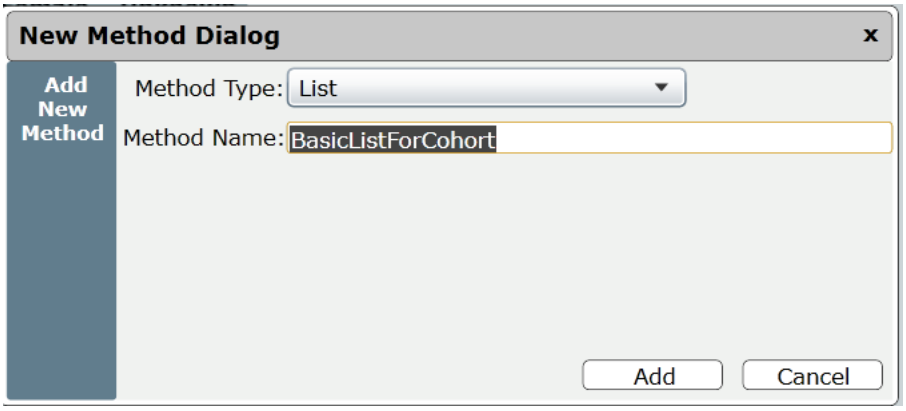
Tutorial 22: List method listing attributes of the cohort
https://www.youtube.com/watch?v=M99VtazqIMo&list=PLf7raPnmlLOeAWU2cNf2jIMDRqQuUTCum&index=22

(equivalent to Browse in the Event Canvas with the added advantage that the results can be saved from session to session).

First, we will do a quick and dirty method of just looking at attributes of the pneumonia cohort itself.

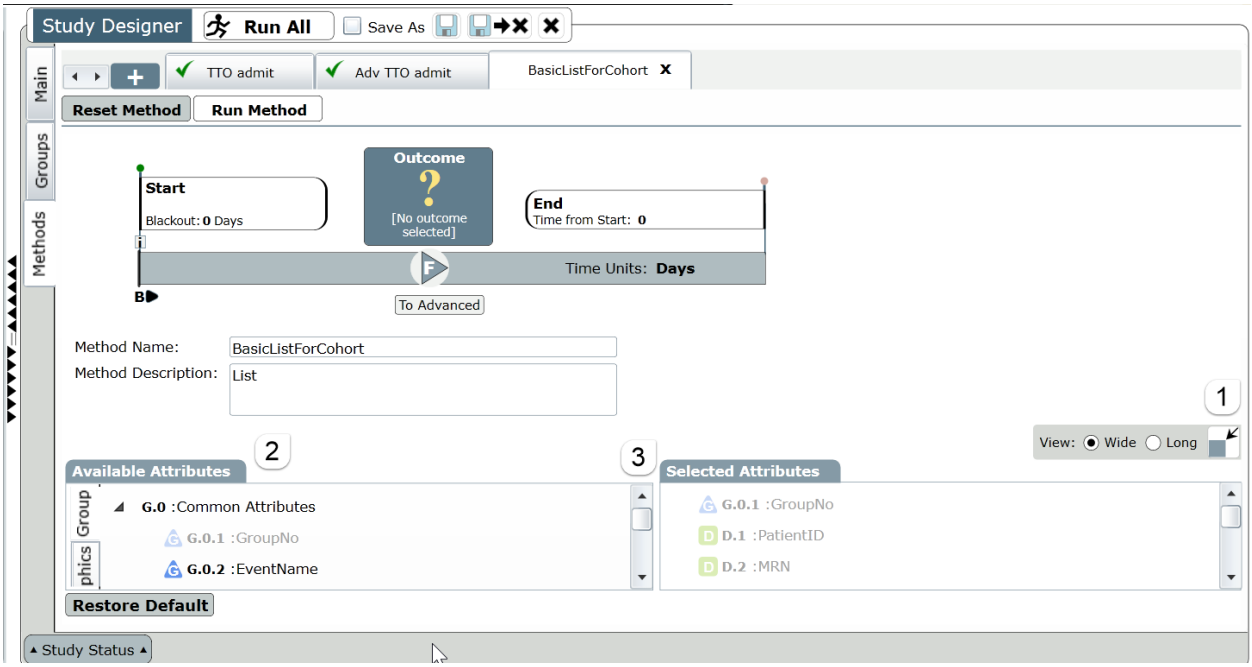
Now move to the pneumonia Readmit Study that you built before and Add a new Method the **List method**.

.



Creating a Method called “Basic List for Cohort”

Left click on Add.



To get information just on the cohort not on any outcome, we can ignore the racetrack paradigm and go directly to the list populator below.

Note you are ignoring both the simple method and the advanced method because all you are doing is looking at the attributes of the cohort itself.

You are going immediately to the **bottom half of the screen,** an area that I am referring to as **the list populator.**

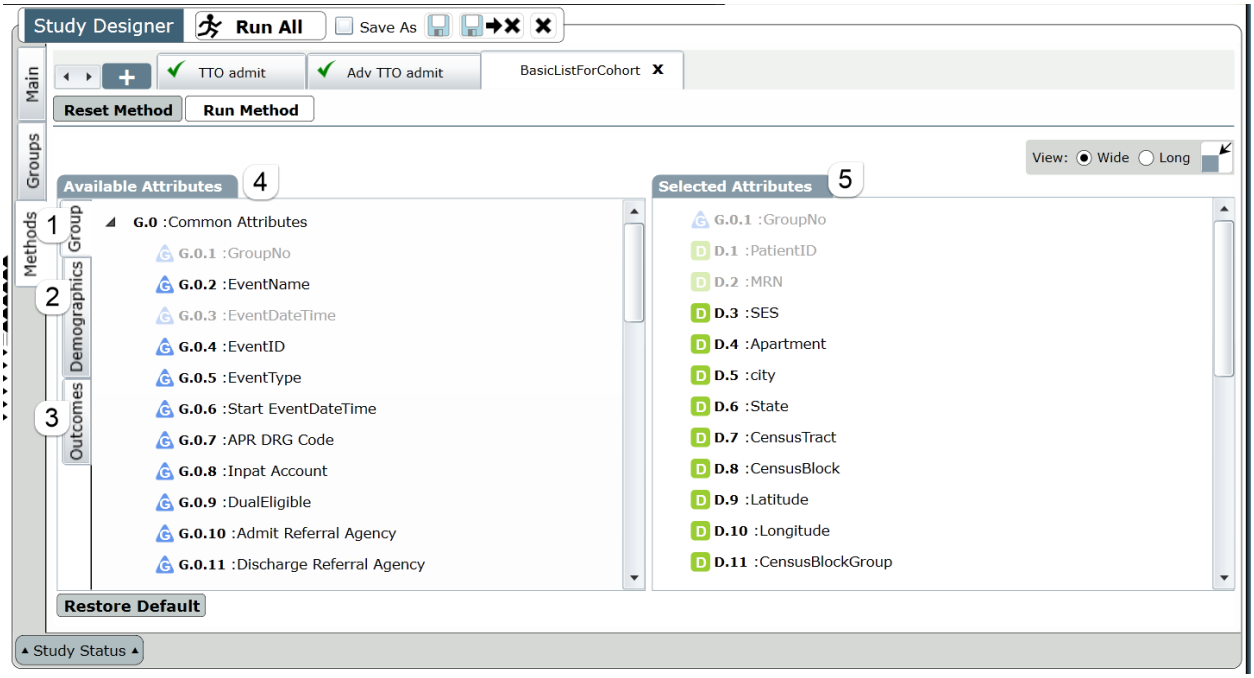
We note symbol (1) which is a toggle switch that will maximize the image of the List populator.

The list populator moves attributes from “available attributes” (2) to “selected attributes”(3).

Some of the selected attributes are brought over by default.

Maximize the list populator section of the screen by Left clicking on (1).

Resulting in:

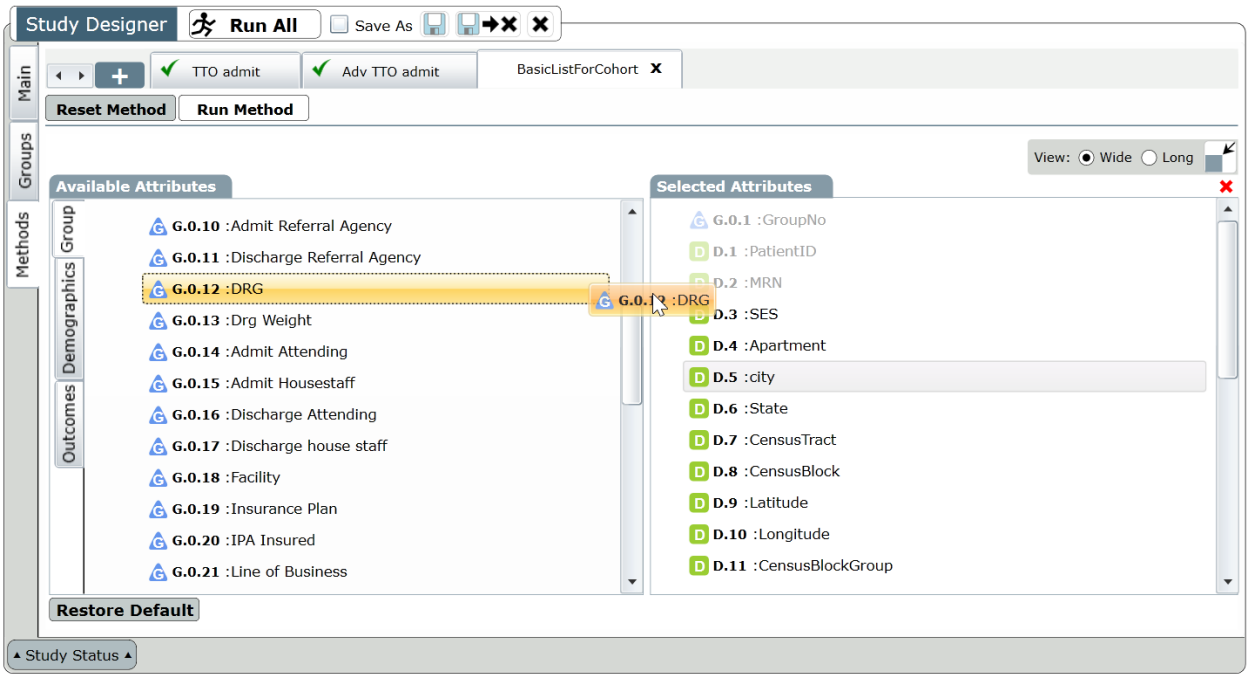


Available attributes that can be moved from 4 to 5 are now very visible

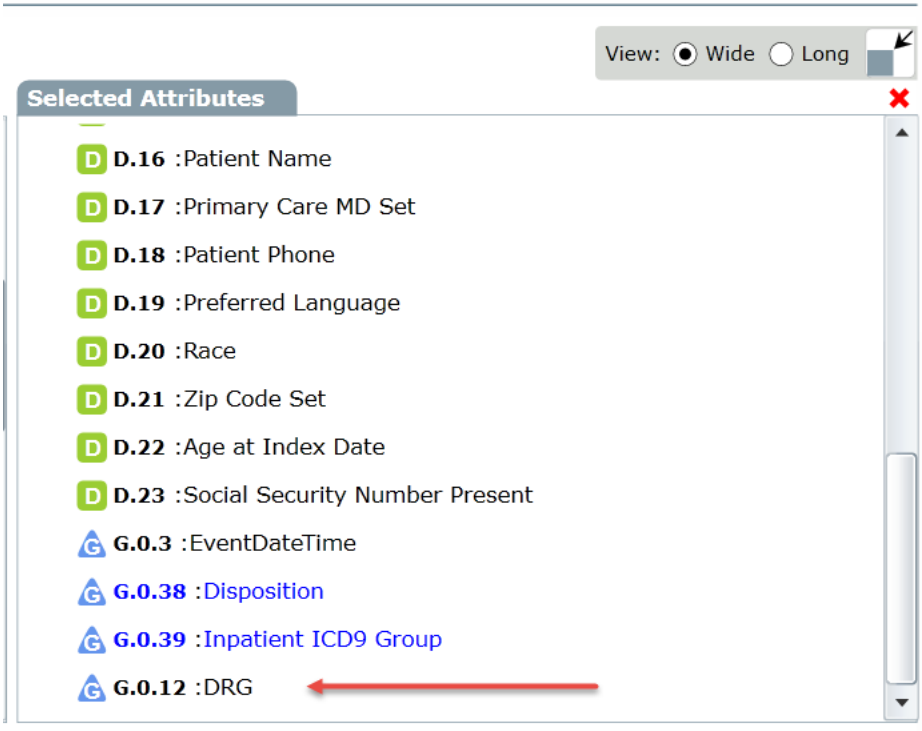
1-Group attributes are visible when you left click on Group (1) within the BasicListforCohort Method. Grayed out attributes (in the Available attributes section (4) have already been selected and appear in the selected attributes section (5).

To select new attributes, Left click on the “Available attribute” (to select more than one available attribute hold control key down while you left click on multiple attributes) then drag to the selected attribute pane on the right.

Drag “DRG” to the right.



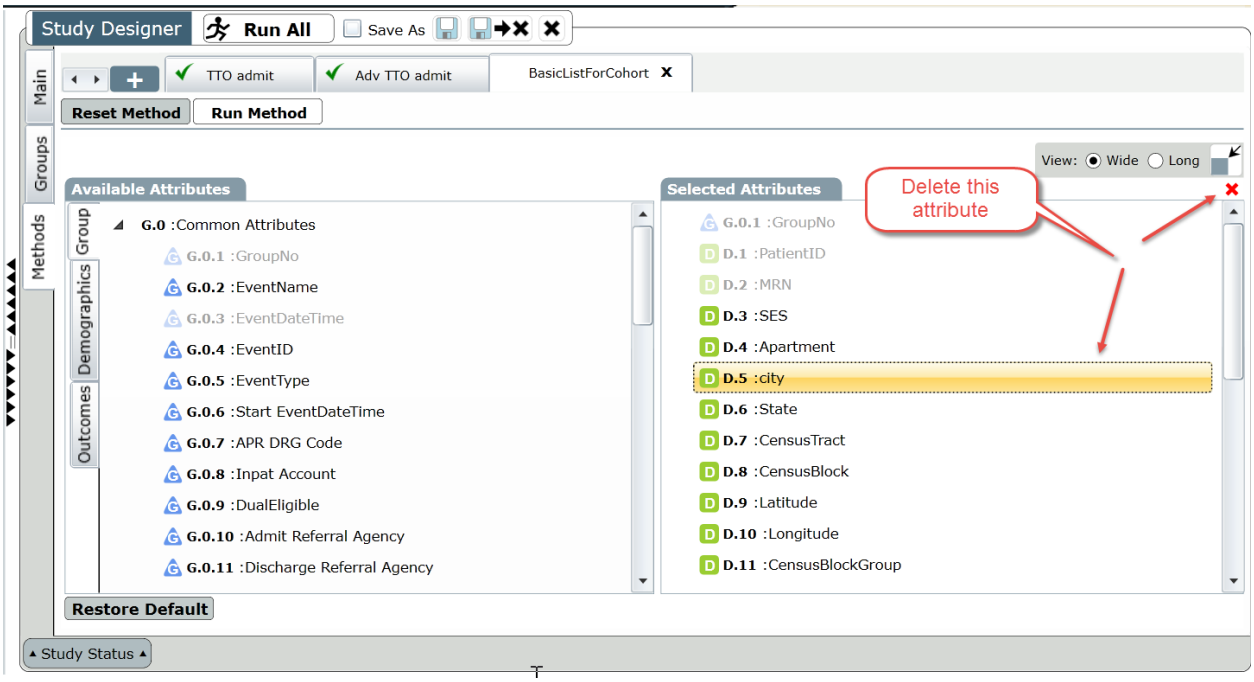
Now you see DRG in the Selected Attribute List:



2-Demographic attributes can be made visible when you left click on Demographics tab (2).

3- Later we will show you how to build an outcome using the simple method racetrack paradigm or advanced method using the Analysis Definition, to pull the outcome attributes over to selected outcomes as well.

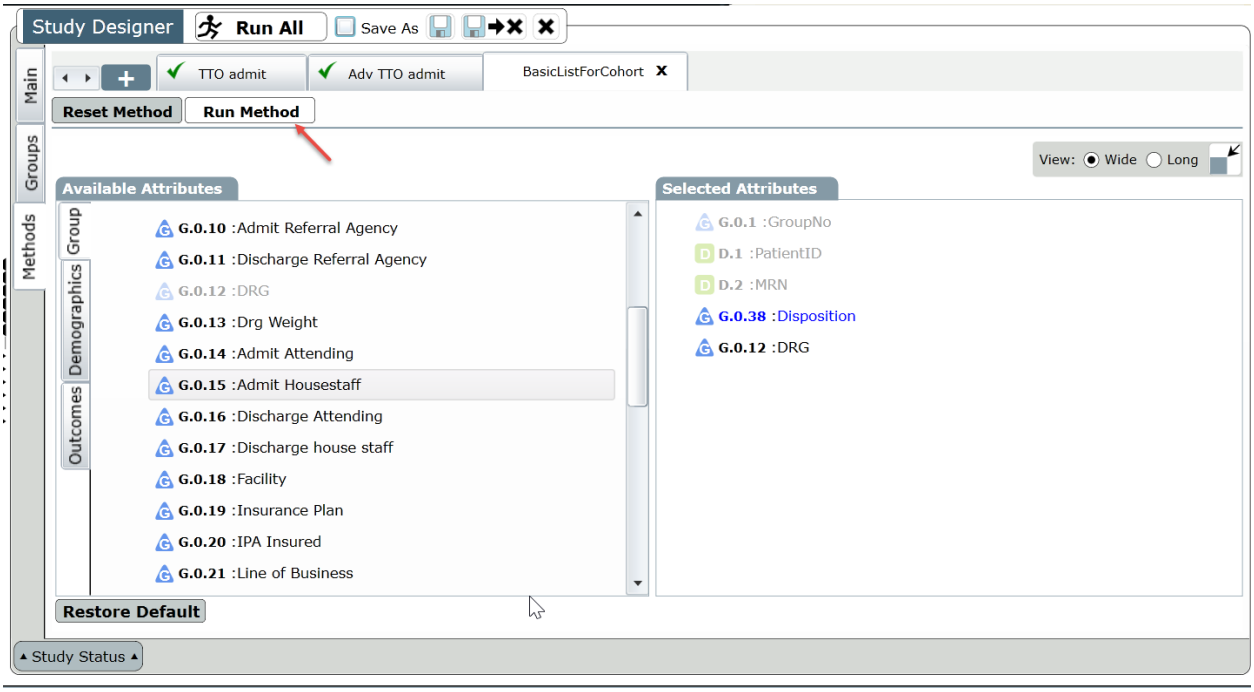
If you want to eliminate a previously selected attribute, you have to left click on it and then left click on the red x upper right hand side.



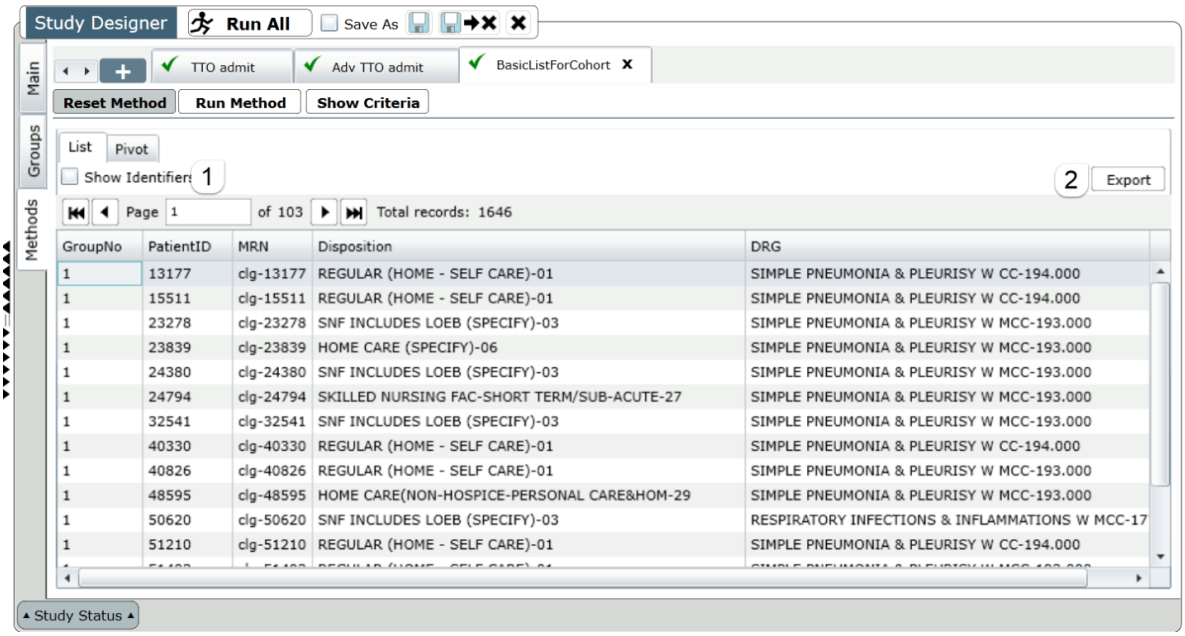
Let's remove all the selected attributes except drg and disposition by holding down the keyboard control key, and then left clicking on each attribute to be removed.

You will notice that all of your selected attributes are highlighted in yellow. Then, left click on the red x.

Left click on Run Method

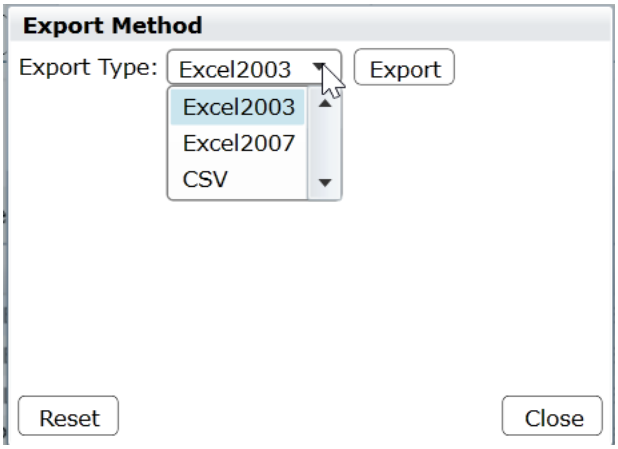


The Result screen then opens up and you see a grid.

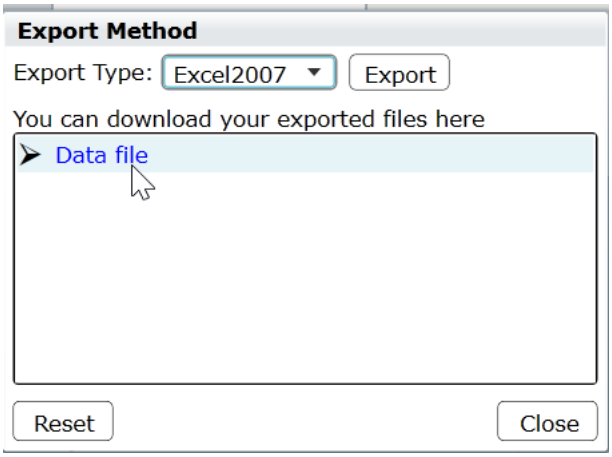

Study Designer
Run All
Save As
Main
Groups
Methods
TTO admit
Adv TTO admit
BasicListForCohort
Reset Method
Run Method
Show Criteria
List
Pivot
Show Identifiers
1
2
Export
Page 1 of 103
Total records: 1646
GroupNo PatientID MRN Disposition DRG
1 13177 clg-13177 REGULAR (HOME - SELF CARE)-01 SIMPLE PNEUMONIA & PLEURISY W CC-194.000
1 15511 clg-15511 REGULAR (HOME - SELF CARE)-01 SIMPLE PNEUMONIA & PLEURISY W CC-194.000
1 23278 clg-23278 SNF INCLUDES LOEB (SPECIFY)-03 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 23839 clg-23839 HOME CARE (SPECIFY)-06 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 24380 clg-24380 SNF INCLUDES LOEB (SPECIFY)-03 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 24794 clg-24794 SKILLED NURSING FAC-SHORT TERM/SUB-ACUTE-27 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 32541 clg-32541 SNF INCLUDES LOEB (SPECIFY)-03 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 40330 clg-40330 REGULAR (HOME - SELF CARE)-01 SIMPLE PNEUMONIA & PLEURISY W CC-194.000
1 40826 clg-40826 REGULAR (HOME - SELF CARE)-01 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 48595 clg-48595 HOME CARE(NON-HOSPICE-PERSONAL CARE&HOM-29 SIMPLE PNEUMONIA & PLEURISY W MCC-193.000
1 50620 clg-50620 SNF INCLUDES LOEB (SPECIFY)-03 RESPIRATORY INFECTIONS & INFLAMMATIONS W MCC-17
1 51210 clg-51210 REGULAR (HOME - SELF CARE)-01 SIMPLE PNEUMONIA & PLEURISY W CC-194.000
Study Status

1-If you need identifiers (and you have been granted privilege you will find a **show identifier** button which) you can left click on to show identifiers

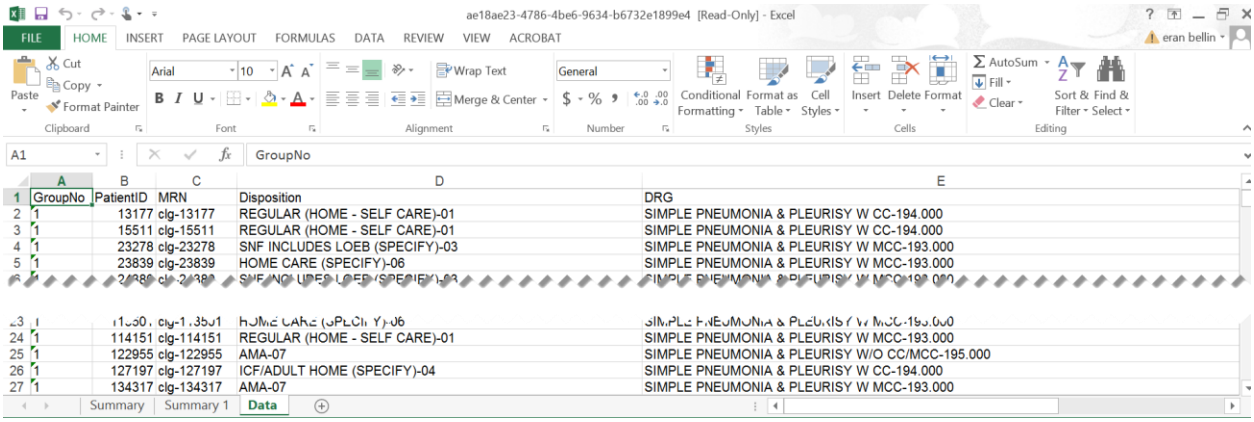
2- If you want to export the data, Left click on the export button.



Choose Excel 2007 and then left click on export



Now left click on Data File and the spreadsheet will open up with multiple tabs. The first tabs are documentation for the cohorts and for the study method. The last tab is the spreadsheet with the data.



Now “Save” the Study Designer.

List Method When you want to see attributes that were not used in the building of the original cohort

Tutorial 23: List method listing attributes of events not involved in the cohort build
https://youtu.be/jhKGypDUU-k

In our previous discussion, I showed you how to obtain attributes belonging to the cohort's index event. But suppose you wanted to look at other event types that were not involved in the cohort build.

Using our pneumonia patient example: Suppose we wanted to see the first White Blood Cell count of the hospital admission, or the first cardiac echo which occurred in the six months preceding the **discharge.** Neither of these events were involved in building the cohort, but they are of interest to us. We want to use the machinery of the List Method to find these events and obtain specific values.

Our goal: Produce from List Method in a single spreadsheet

- Attributes from the cohort's index event.
    - Disposition of the original pneumonia discharge. Did they get discharged to a nursing home?
    - The APR DRG of the original pneumonia.

      These are two attributes of the original pneumonia hospitalization and are inherent to the event type.

- The First White cell Blood Count during the Admission.

  This is an attribute of an event that was not used to build the cohort.
  "First White blood count during" is a lab event that you are relating to the cohort through a "When In" temporal operator pointing from the Analysis definition to the Cohort's index Event.

- The last ejection fraction from the latest Cardiac Echo performed prior to the hospitalization in the preceding 180 days. (Best LV ejection fraction)

Because you now want to obtain attributes from events not belonging to the index event, White Blood Count, and Echo Ejection Fraction, you must now select what are called "Outcome Event Attributes".

If there were only one outcome event and it was the Earliest outcome event, then you could use the racetrack paradigm in the simple mode.

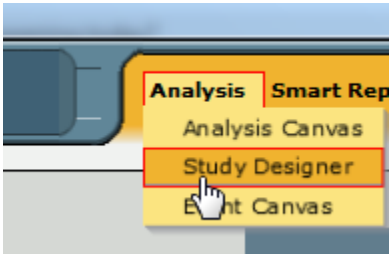
Because you want more than one outcome event, in our case WBC's and Cardiac Echoes, you must go to the Advanced Mode and build two Analysis Definitions – one to be used to collect the Earliest WBC during the hospitalization and the other to detect the Cardiac echo within 180 days of admission.

Even if you had wanted only the White blood count event, you would have needed the advanced method to use the “When In ” duration Temporal operator.

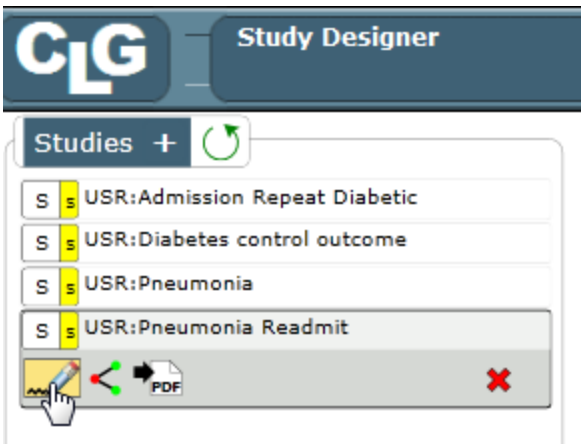
The Simple method only permits an implicit “Within” time operator.

We will now proceed to use the Advanced Method so we can look at all these three events at the same time in one spreadsheet.

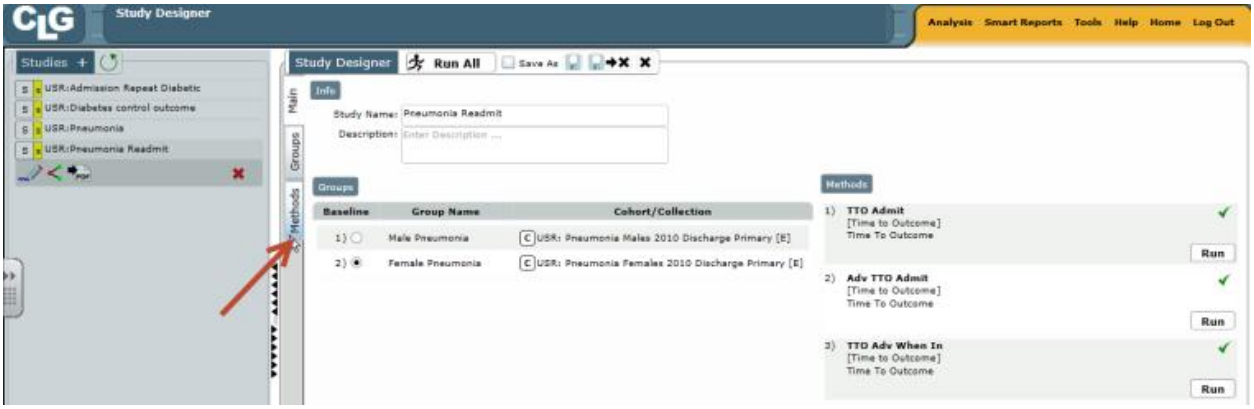
Open a new method in Study Designer.



Reopen the Pneumonia Readmit Study.



Hover over the methods tab and left click.

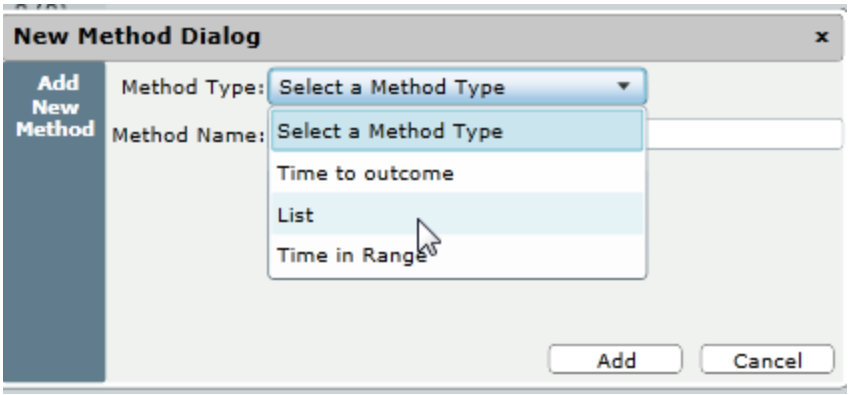


Click the + sign to add another method.

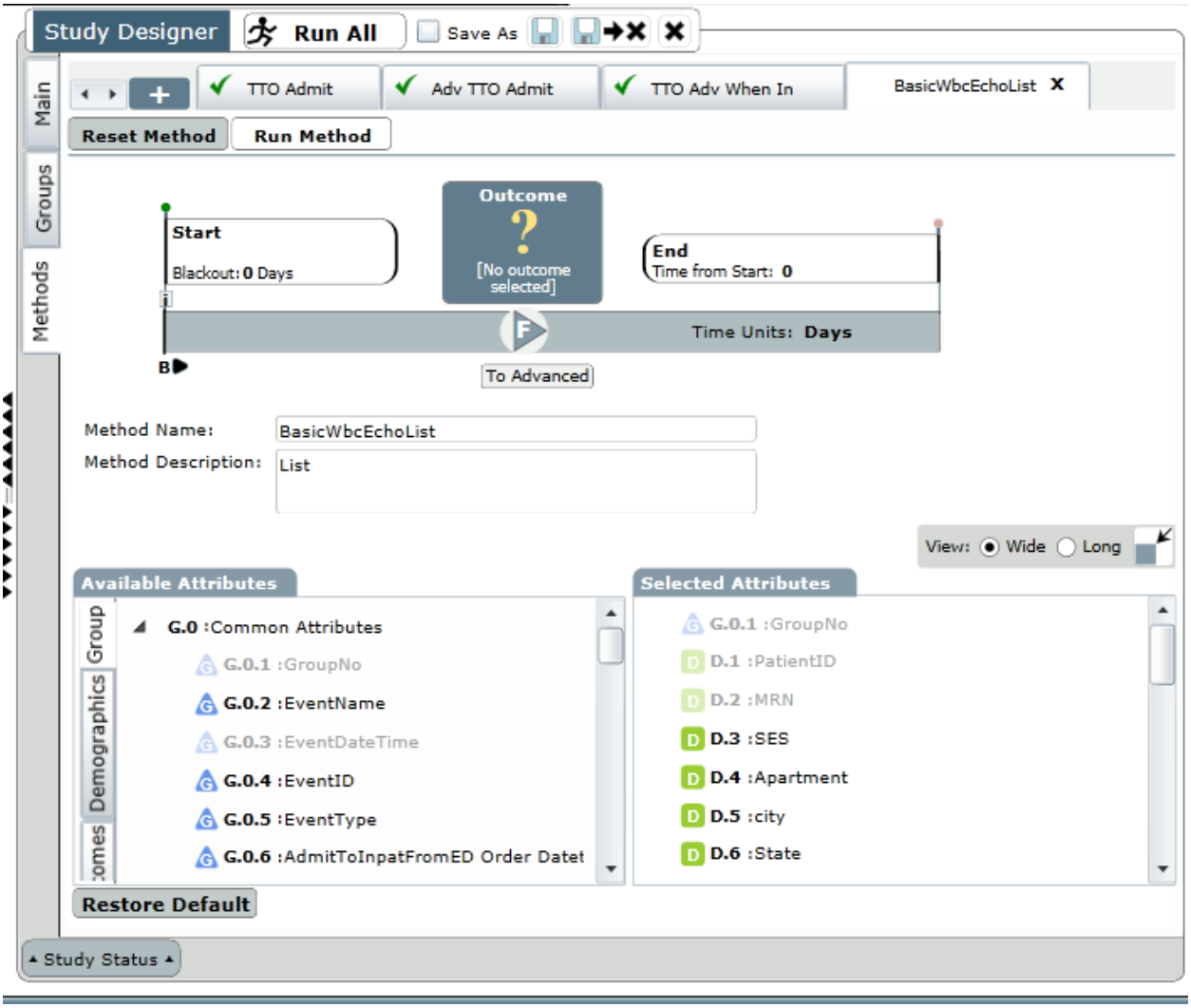
Choose List from the drop down.

Name the Method “BasicWbcEchoList”.

Left click Add.



The image below appears.



First we are going to concentrate on those attributes inherent to the cohort member's index event.

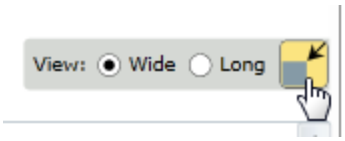
> The attributes used in building the cohort are automatically moved from the "Available Attributes" to "Selected Attributes".
>
> Those attributes that were not included in the conditions used to select cohort membership have not been brought over.

A number of demographics are automatically brought over.

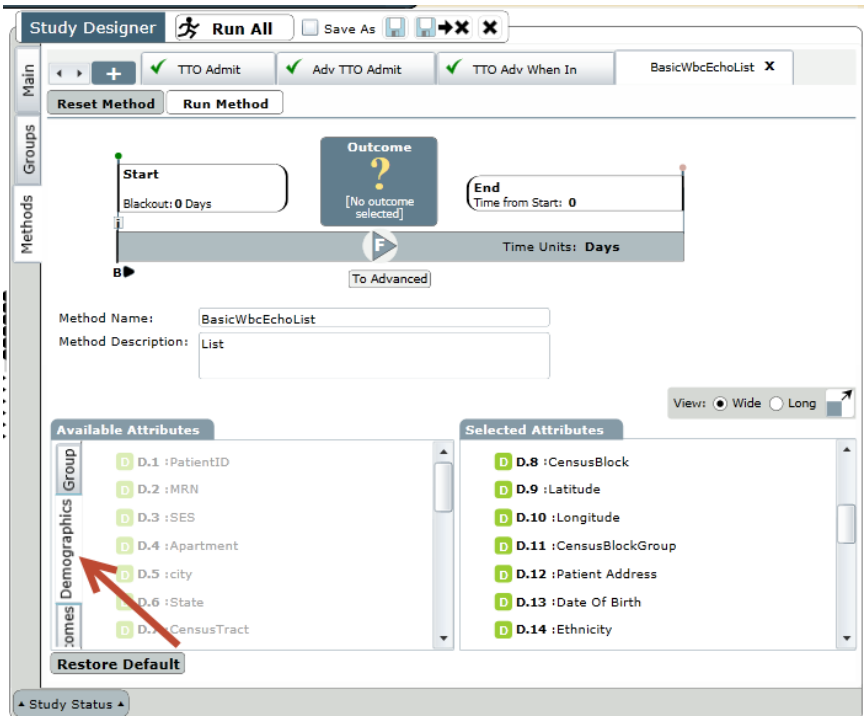
We are only interested in keeping SES, Gender, Race, Ethnicity, Age at Index, and Primary Language.

We must remove the rest.

Click on List populator maximizer



Left click on the Demographics tab.



Note the large number of greyed out “Available Attributes”.

We want to remove unnecessary selected attributes so that the only remaining demographic attributes are: SES, Gender, Race, Ethnicity, Age at Index, and Primary Language.

Hit the Crtl + left click to highlight unwanted demographic “Selected Attributes”.

Demographic attributes are preceded by a BIG GREEN D.

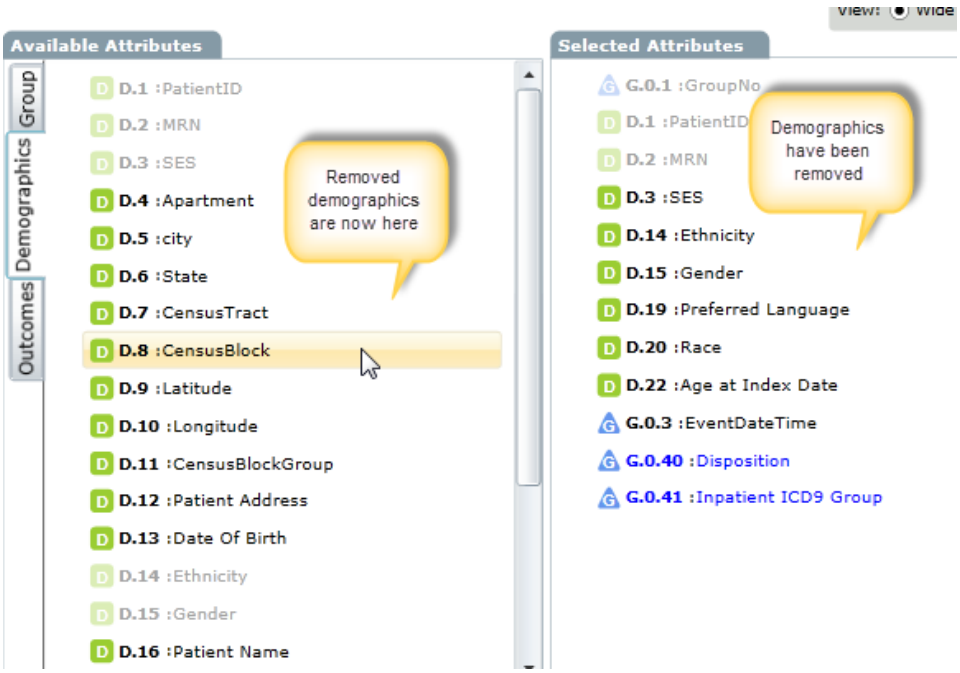
DO NOT remove the “Selected Attributes” from the group in BLUE G.

> Those attributes used as conditions on the cohort’s index event are automatically brought over into the selected attributes in BLUE.

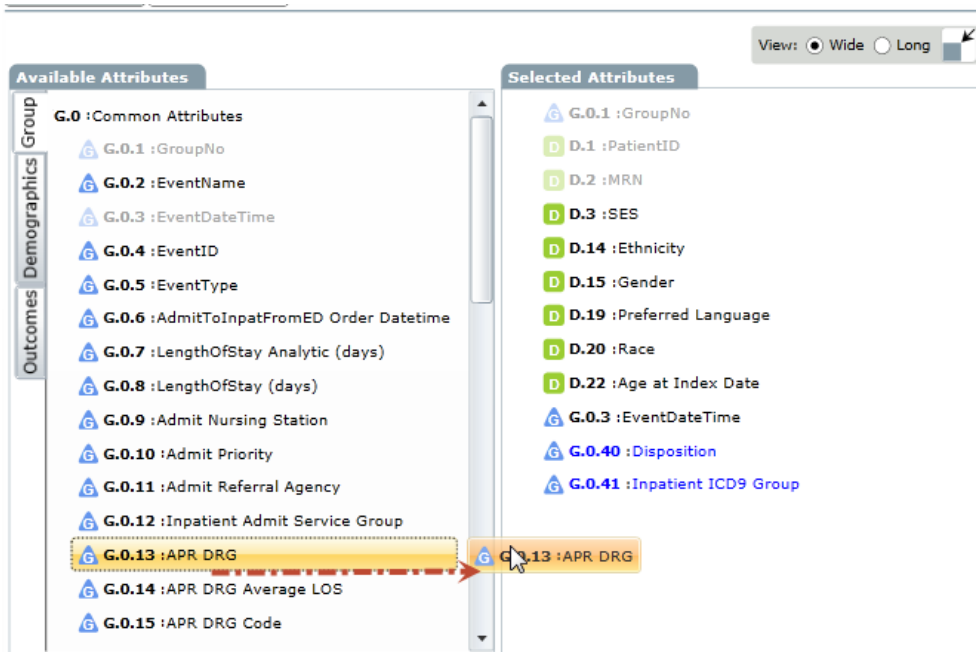
Now we will remove the unnecessary demographics.

Left click the red x.

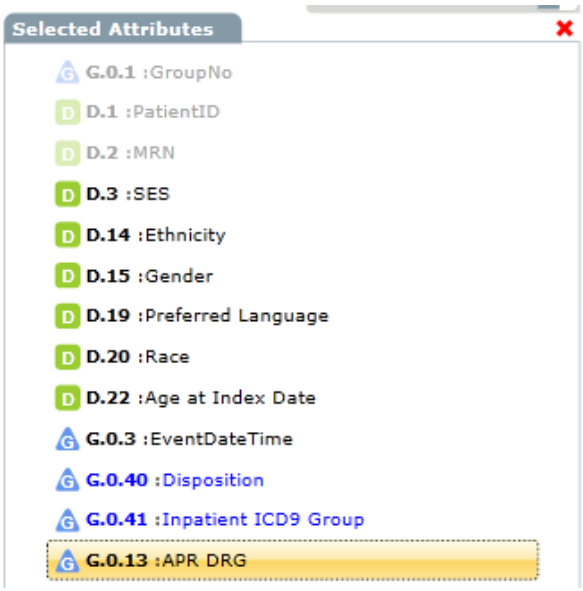
View the list of “Available” and “Selected” Attributes



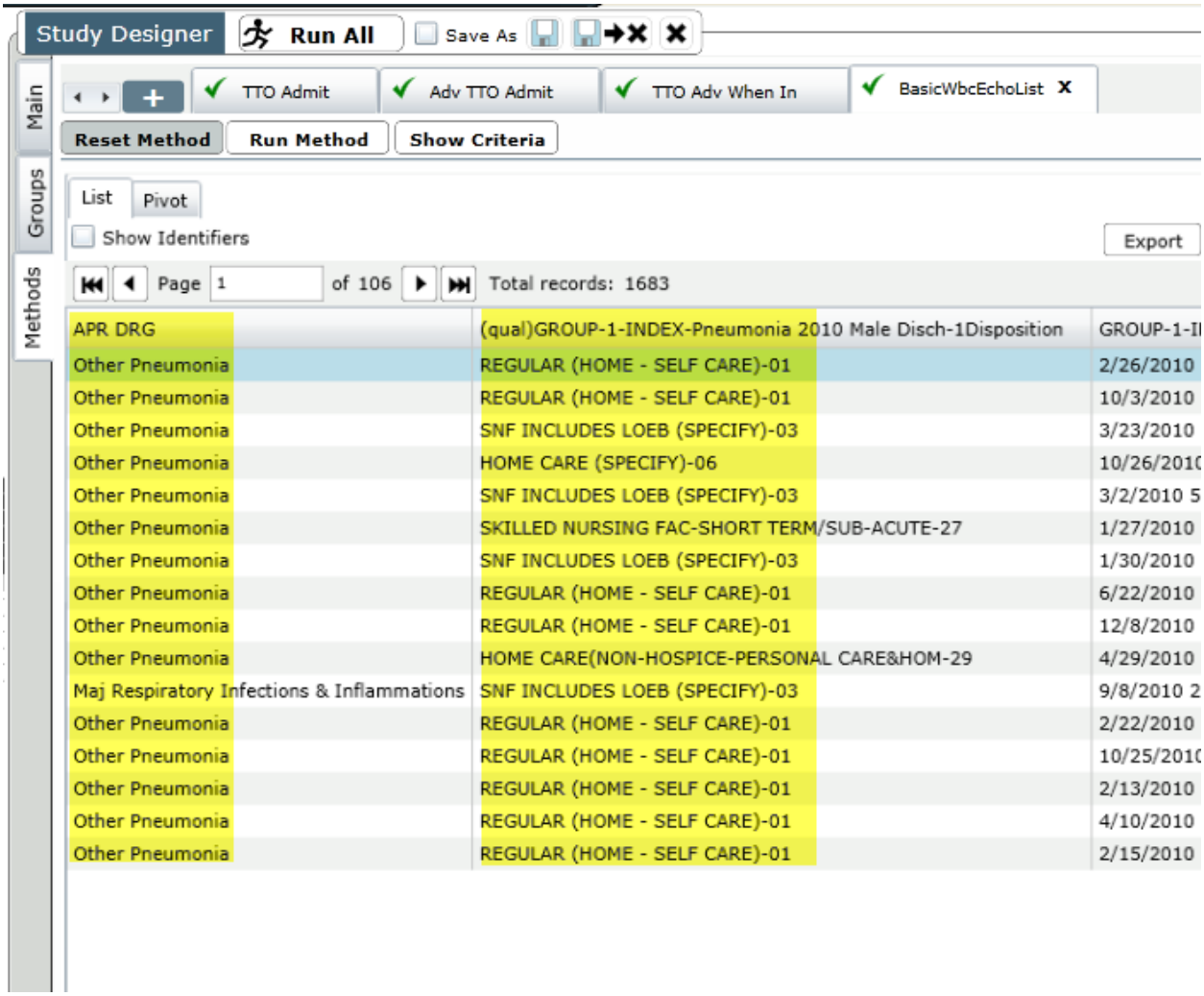
We now want to bring in “APR DRG”. Left click on “APR DRG” and drag over to the “Selected Attributes”.



“APR DRG” now appears in “Selected Attributes”.

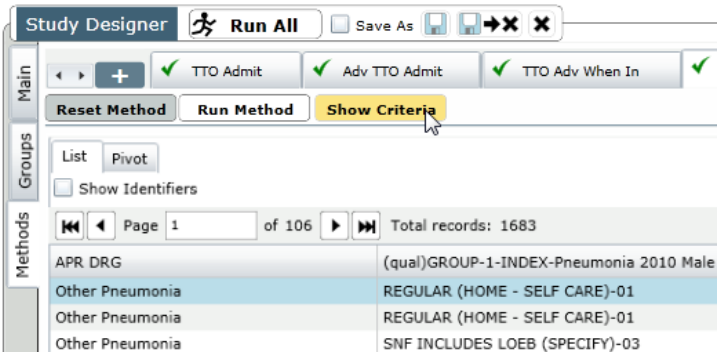


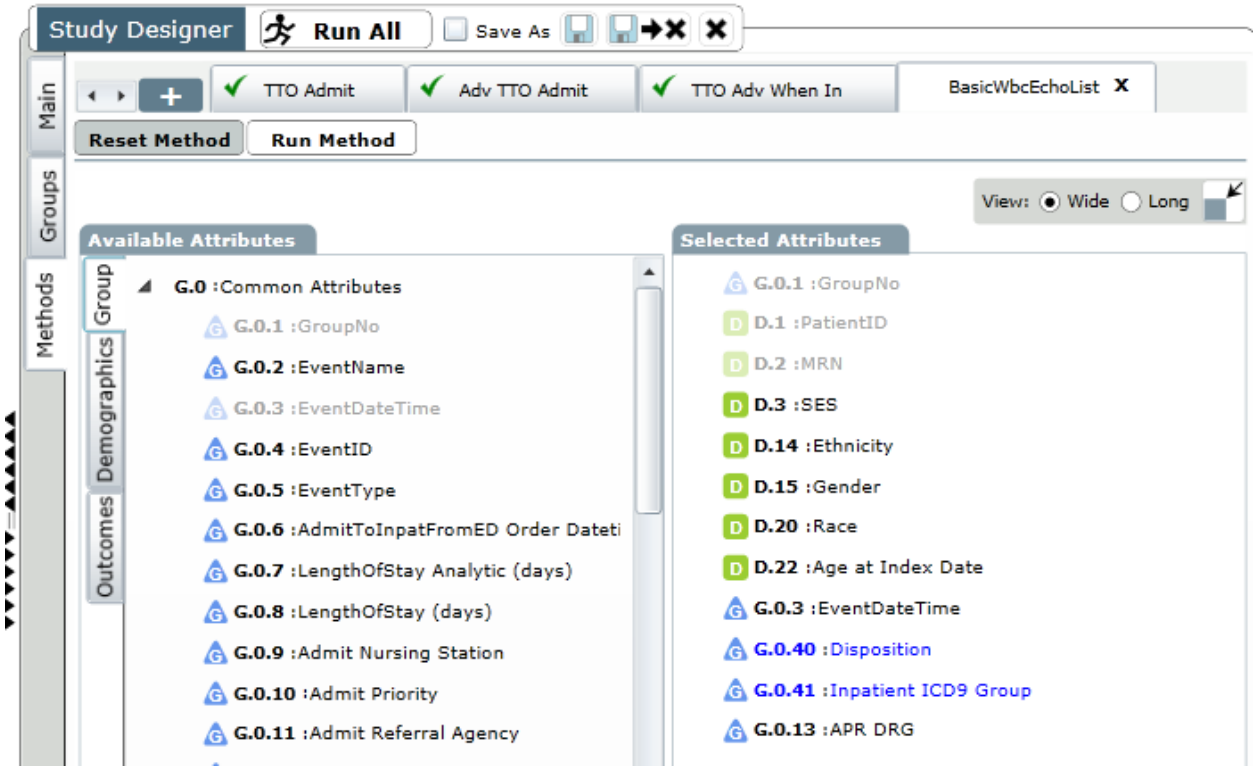
Run the method.


Study Designer
Run All
Save As
Main
Groups
Methods
TTO Admit
Adv TTO Admit
TTO Adv When In
BasicWbcEchoList
Reset Method
Run Method
Show Criteria
List
Pivot
Show Identifiers
Export
Page 1 of 106
Total records: 1683
APR DRG
(qual)GROUP-1-INDEX-Pneumonia 2010 Male Disch-1Disposition
GROUP-1-I
Other Pneumonia REGULAR (HOME - SELF CARE)-01 2/26/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 10/3/2010
Other Pneumonia SNF INCLUDES LOEB (SPECIFY)-03 3/23/2010
Other Pneumonia HOME CARE (SPECIFY)-06 10/26/2010
Other Pneumonia SNF INCLUDES LOEB (SPECIFY)-03 3/2/2010 5
Other Pneumonia SKILLED NURSING FAC-SHORT TERM/SUB-ACUTE-27 1/27/2010
Other Pneumonia SNF INCLUDES LOEB (SPECIFY)-03 1/30/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 6/22/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 12/8/2010
Other Pneumonia HOME CARE(NON-HOSPICE-PERSONAL CARE&HOM-29 4/29/2010
Maj Respiratory Infections & Inflammations SNF INCLUDES LOEB (SPECIFY)-03 9/8/2010 2
Other Pneumonia REGULAR (HOME - SELF CARE)-01 2/22/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 10/25/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 2/13/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 4/10/2010
Other Pneumonia REGULAR (HOME - SELF CARE)-01 2/15/2010

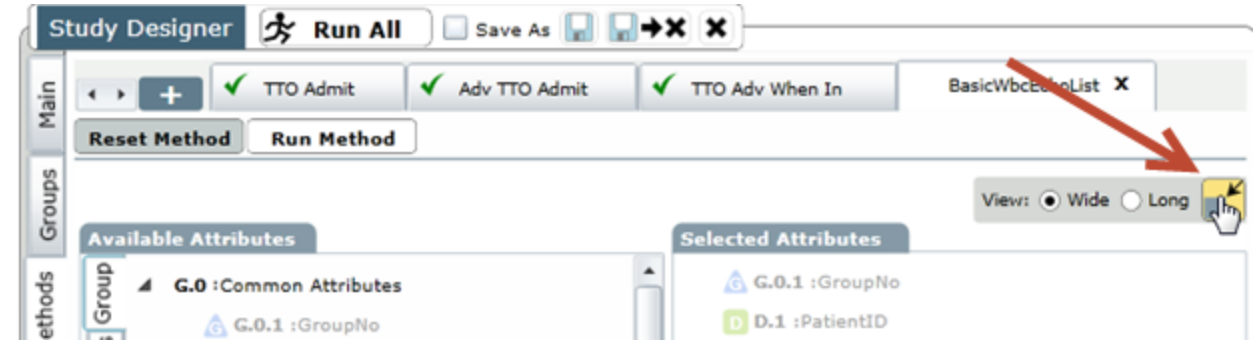
Notice “APR DRG” and “Disposition”.

To return to Study Designer criteria page, hover over “Show Criteria” and left click.

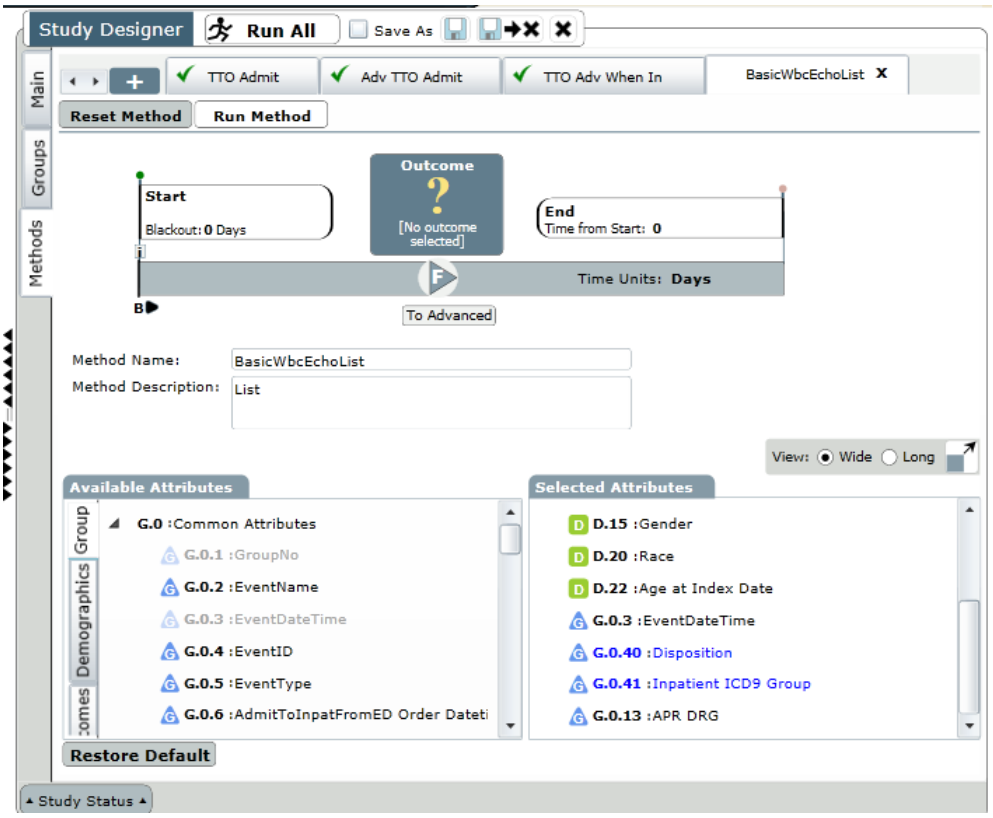




Minimize the list populator.



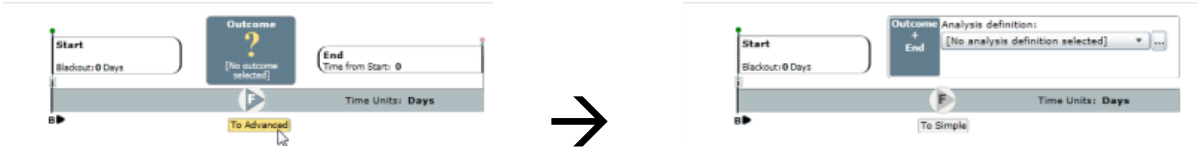
This results in:



The racetrack is in the default “Simple Mode”

We want to change the racetrack metaphor to the advanced mode.

Left click on toggle switch “To Advanced”

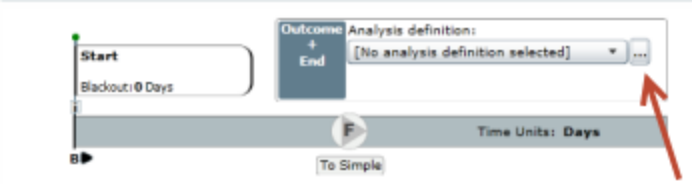


Notice the toggle switch in the “Advanced” mode says “To Simple” meaning that if you want to switch from the “Advanced mode” back to the “Simple mode”, click here.

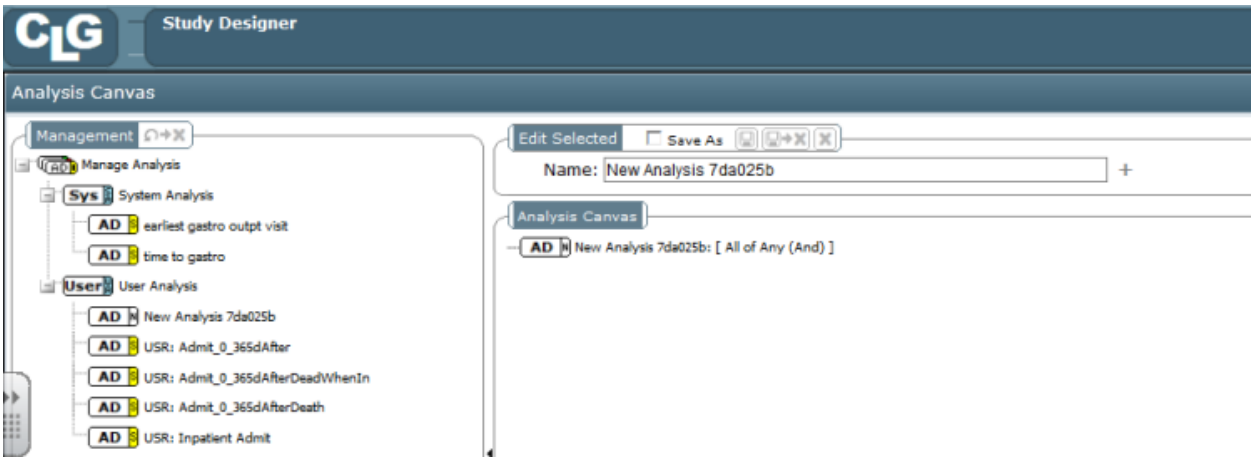
We now want to get the First White Count for each patient in the index hospitalization.

We need to build an Analysis Definition that will find the first white count for each patient in the index hospitalization.

To build an Analysis Definition, left click on the three dotted button.



The Analysis Canvas opens to display the Management pane on the left and the Analysis Canvas on the right.

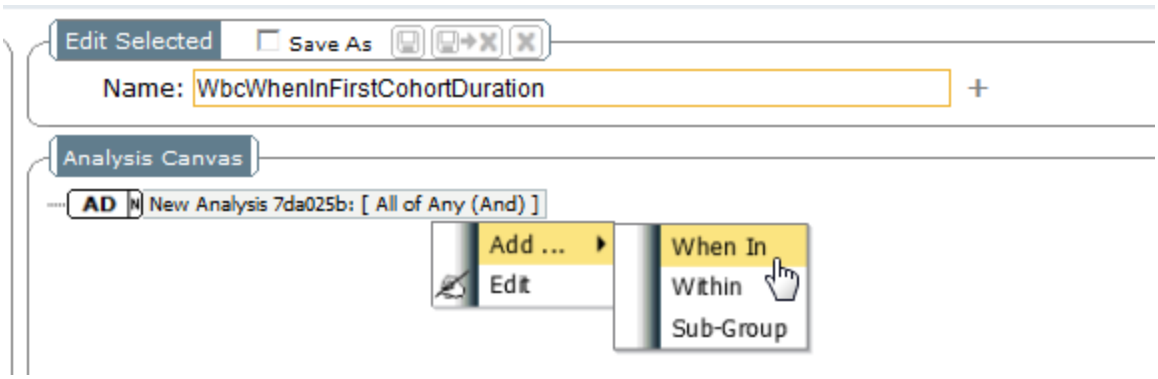


Enter the name: “WbcWhenInFirstCohortDuration”

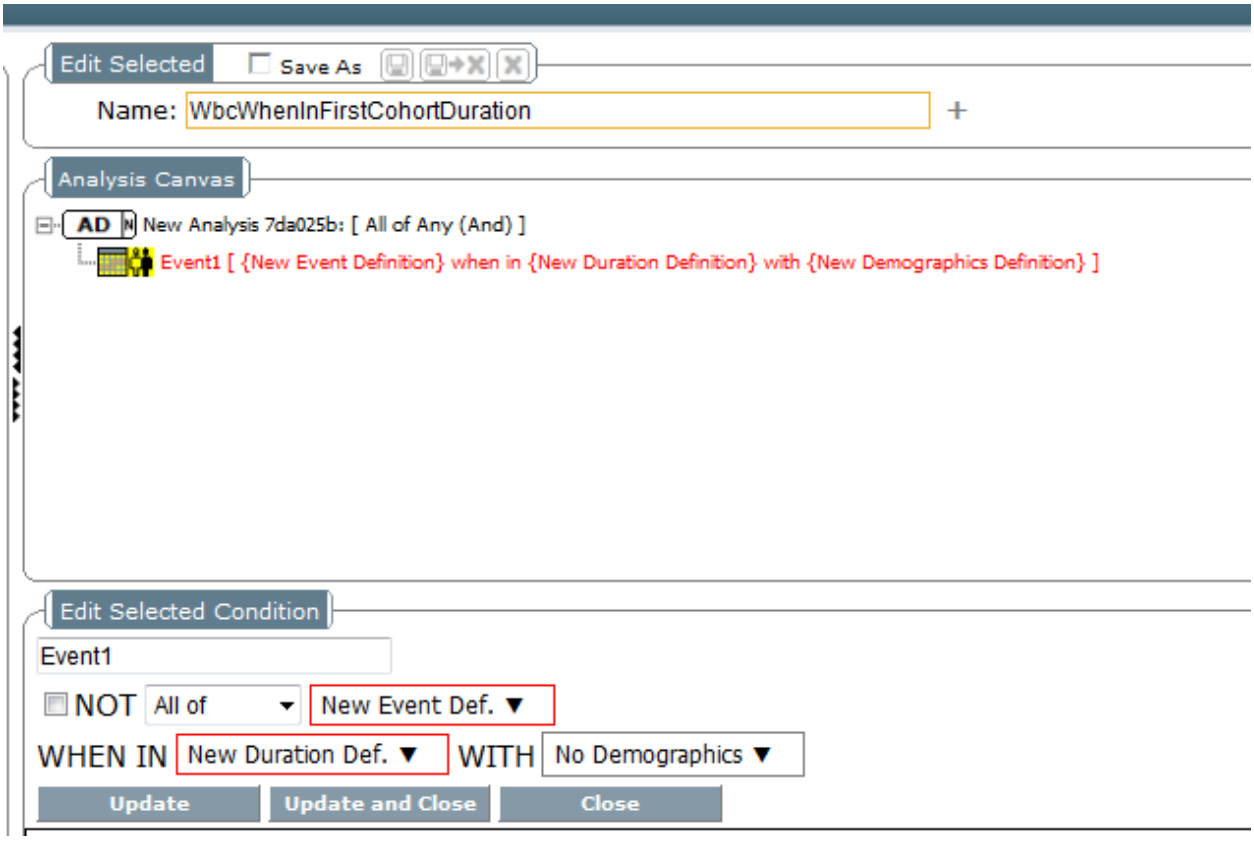
Since we are interested in the White Blood Count’s during the original hospital admission, we need to add a “When In” duration condition.

Right click on the index event line to open the menu.

Left click “When In”.


Edit Selected
Save As
Name: WbcWhenInFirstCohortDuration
Analysis Canvas
AD
New Analysis 7da025b: [All of Any (And)]
Add ...
Edit
When In
Within
Sub-Group

Resulting in:



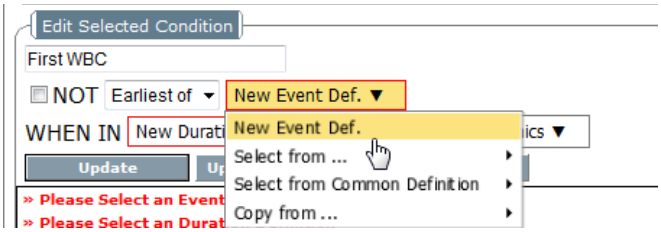
Name the Event1: First WBC

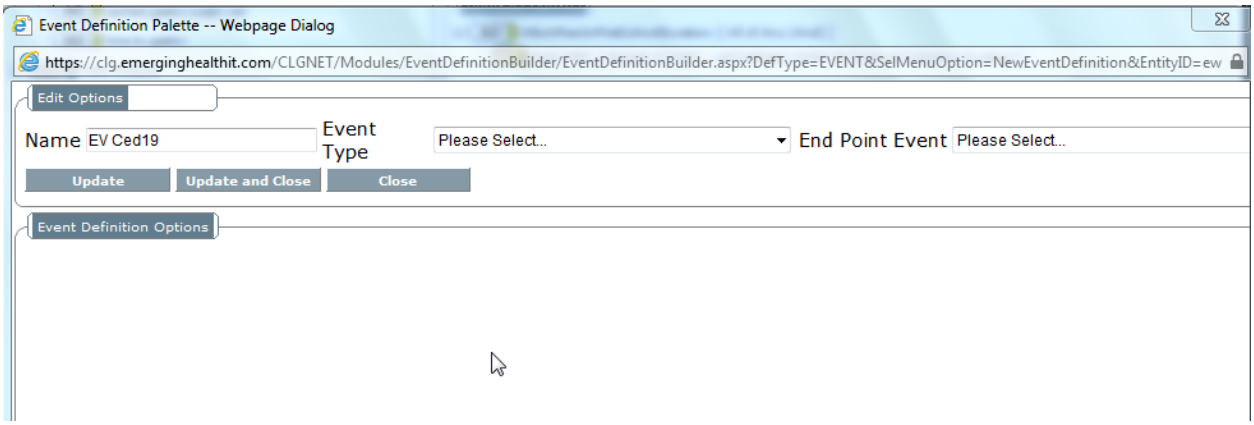
Since we want the first white count during the hospitalization, change “All of” to “Earliest of”

We want to find Wbc Count

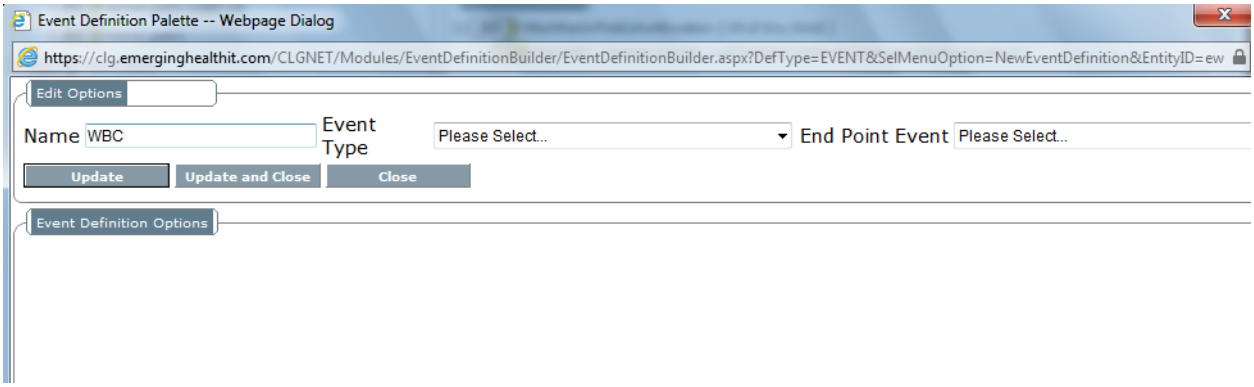
Left Click on the downward arrow of the New Event Def.

Left Click on “New Event”

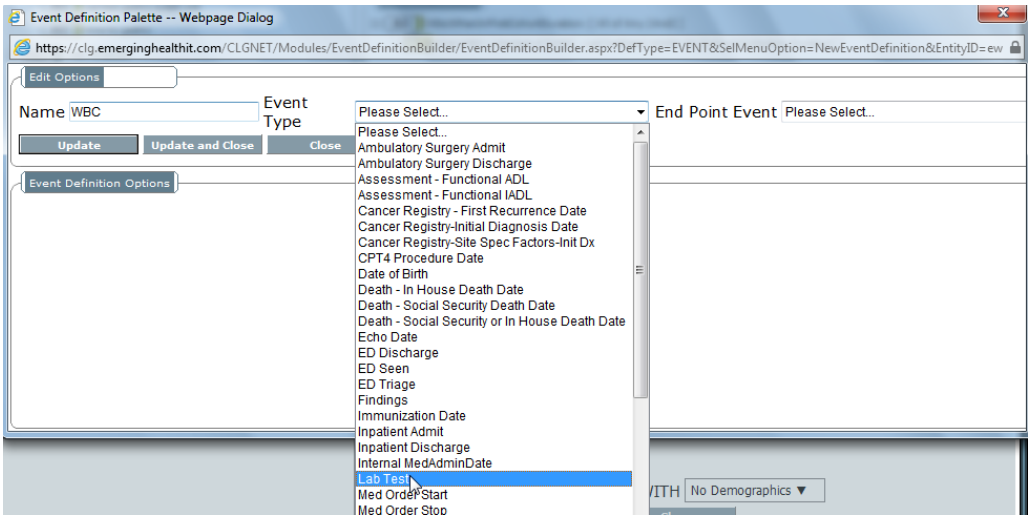


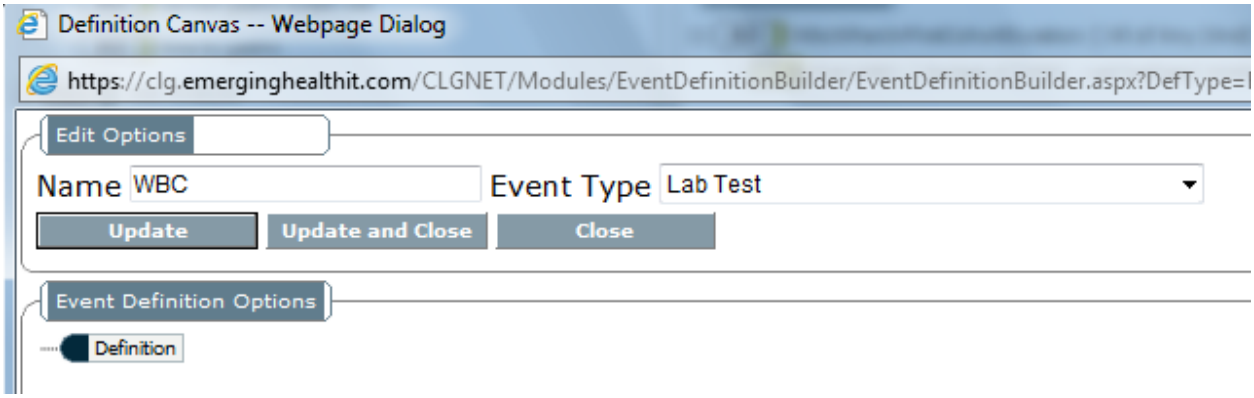


Name the Event Type “WBC”



Choose “Lab Test” from the dropdown menu.





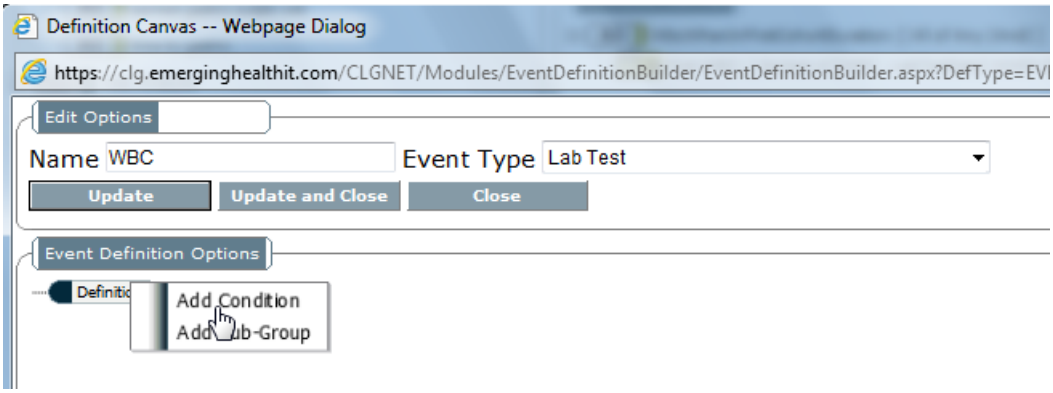
We want Lab Test to be a White Blood cell Count.

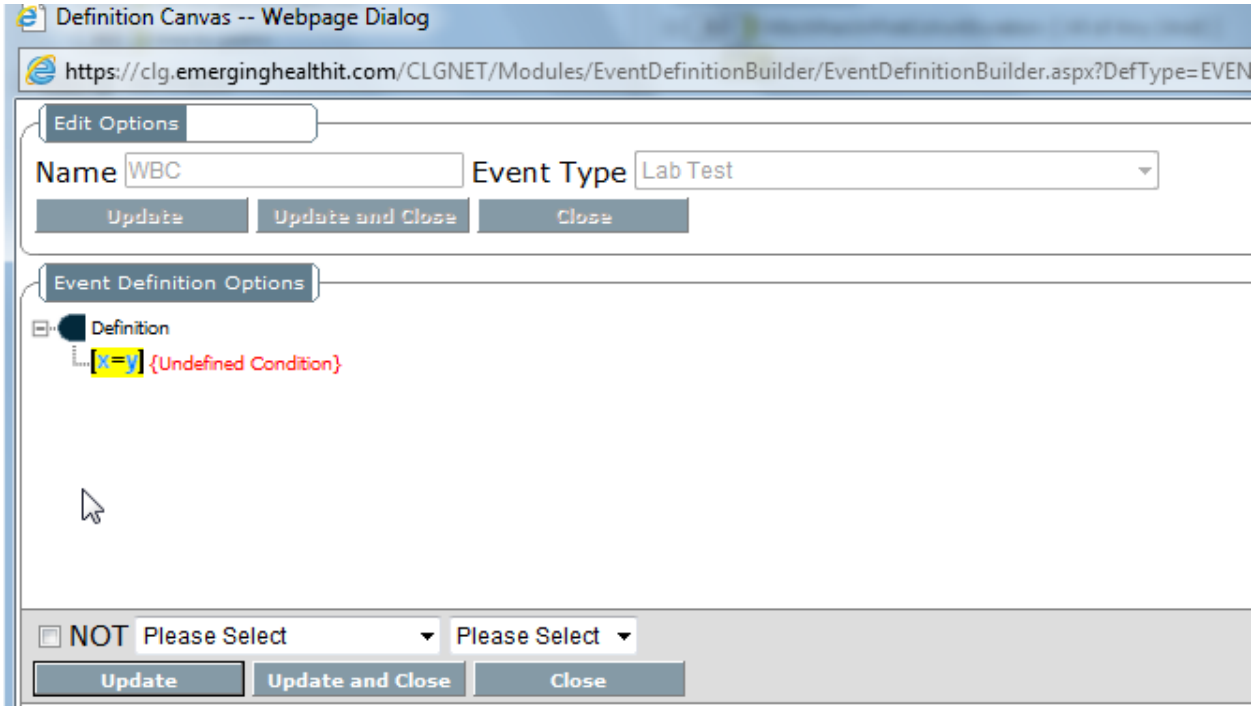
Hover over Definition

A box appears around the word Definition

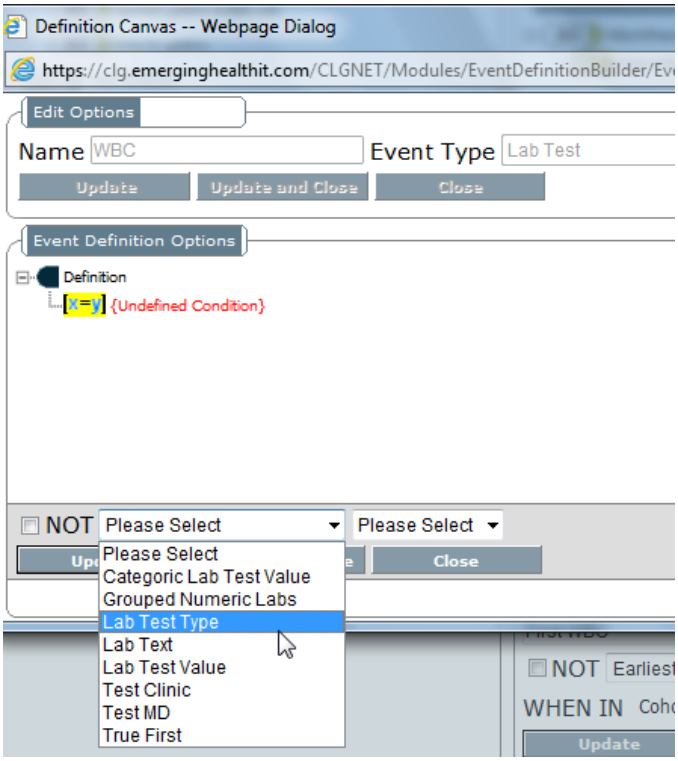
Right Click on Definition

Left Click on add Condition

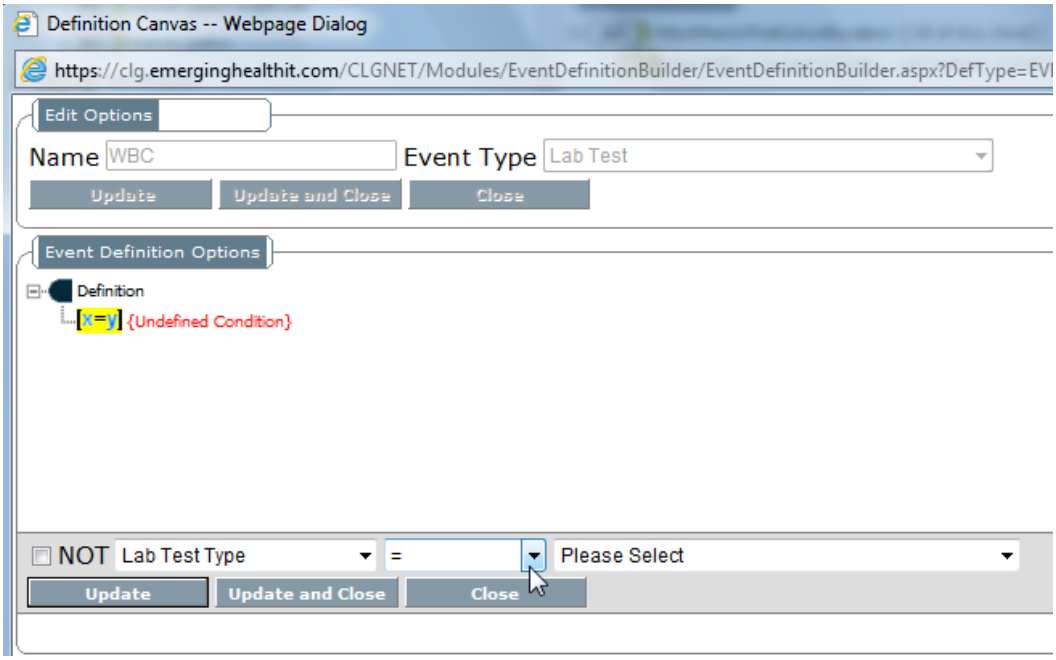




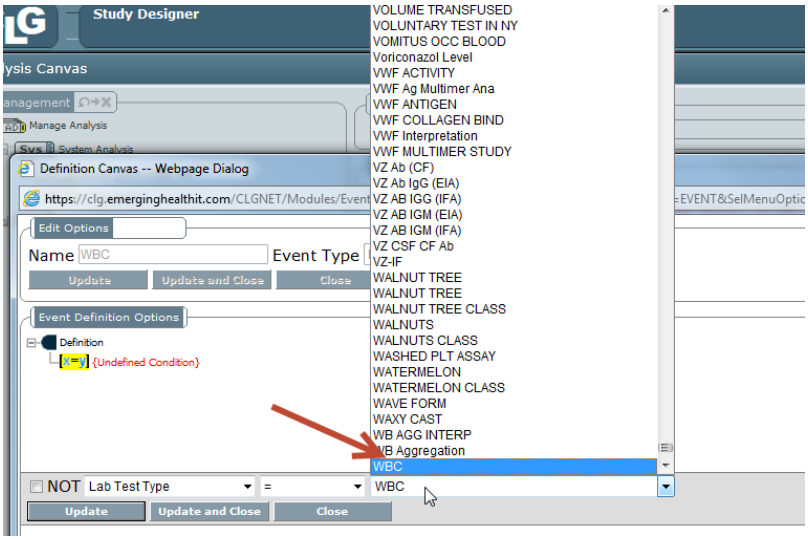
Choose from dropdown menu “Lab Test Type”



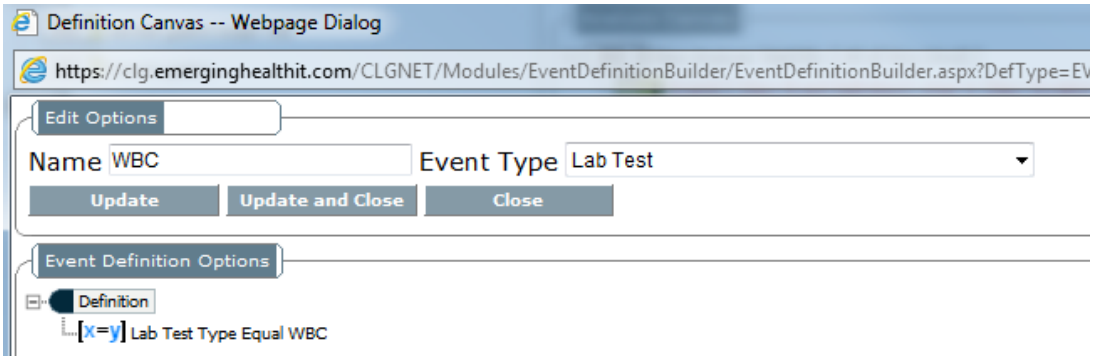
Choose “=”



Choose “WBC”

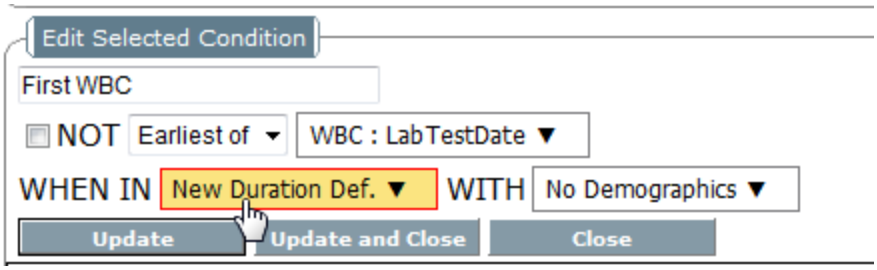


Update and Close.



Update and Close.

We now see the new Event Definition populated with the "WBC: LabTestDate" event we just built.

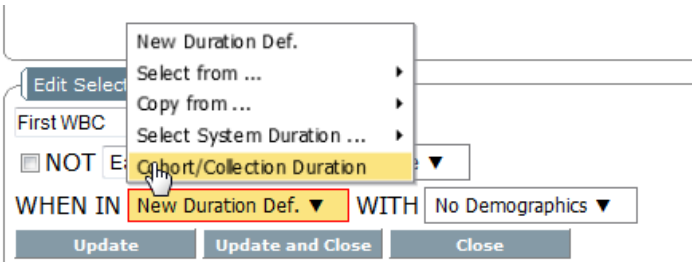


We want to force the White Blood Count to occur **during** the hospitalization.

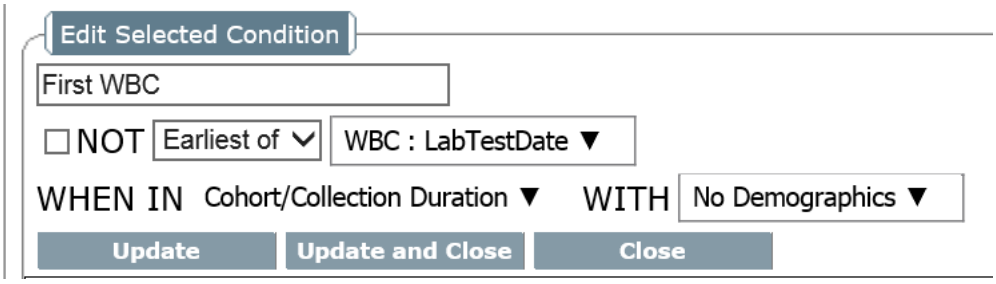
We want the White Blood Count **"When In"** the cohort index event.

Left click on "New Duration Definition" and choose "Cohort/Collection Duration".

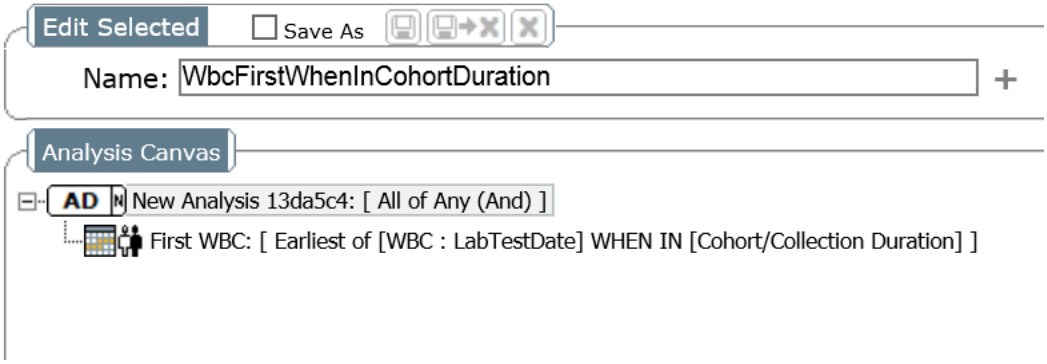
By doing so, White Blood Count will be sought outside of the analysis canvas and during the cohort members index event (the original hospital discharge).



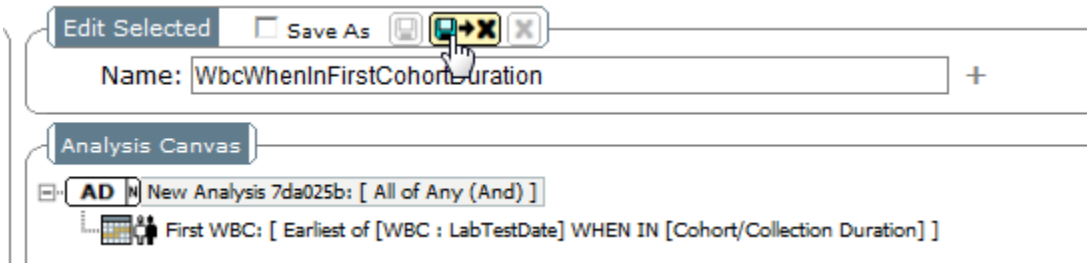
Resulting in:



Update and close



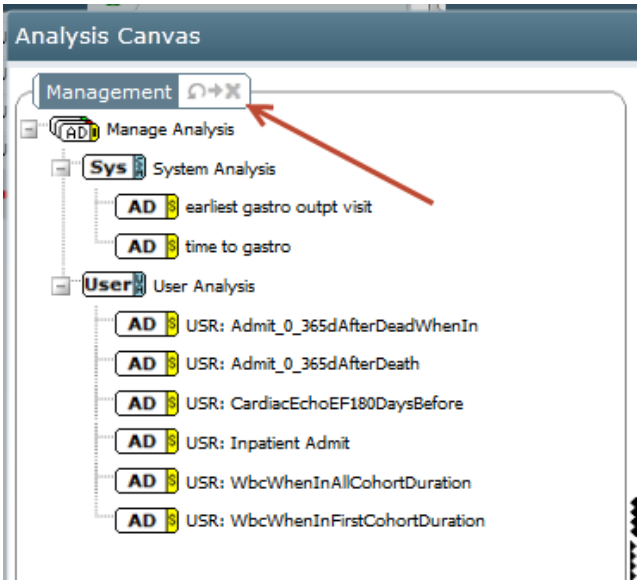
Save and Exit



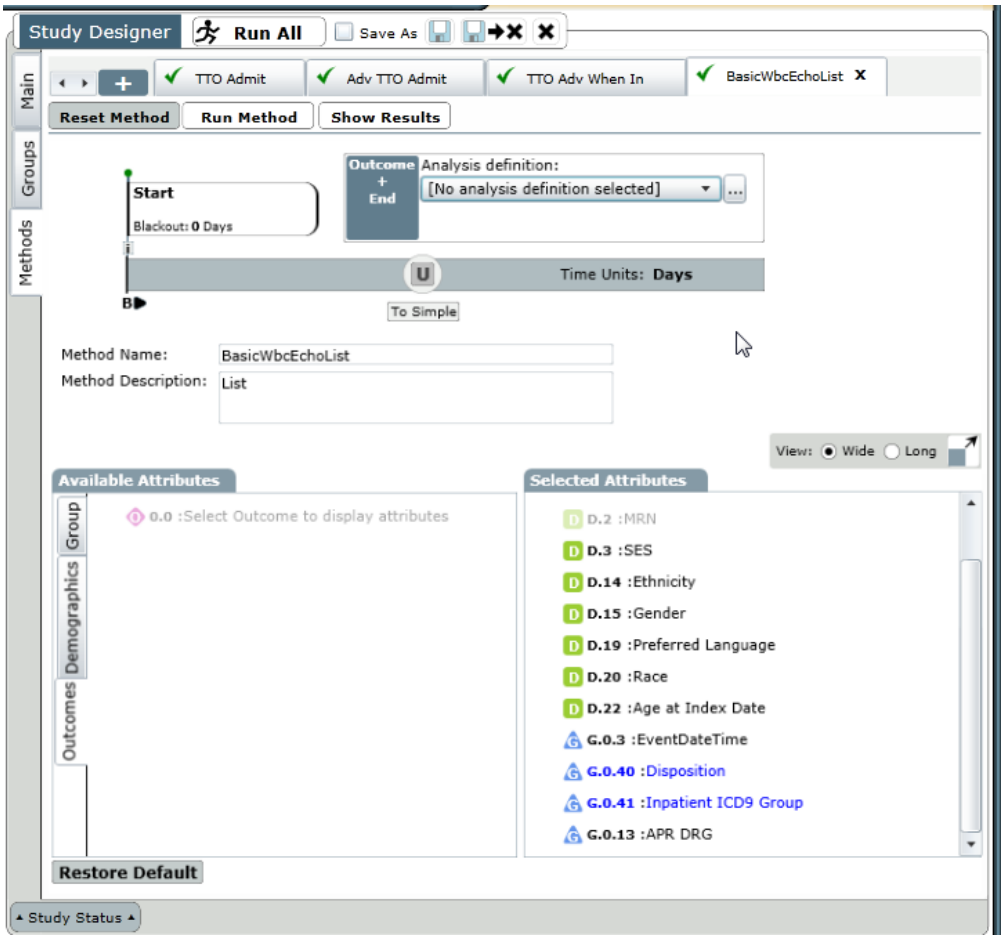
Resulting in:

Circled in the management pane is the Analysis Definition you just built.

Now exit.



Resulting in:



Note there are no “Available Attributes” in the Outcomes tab.

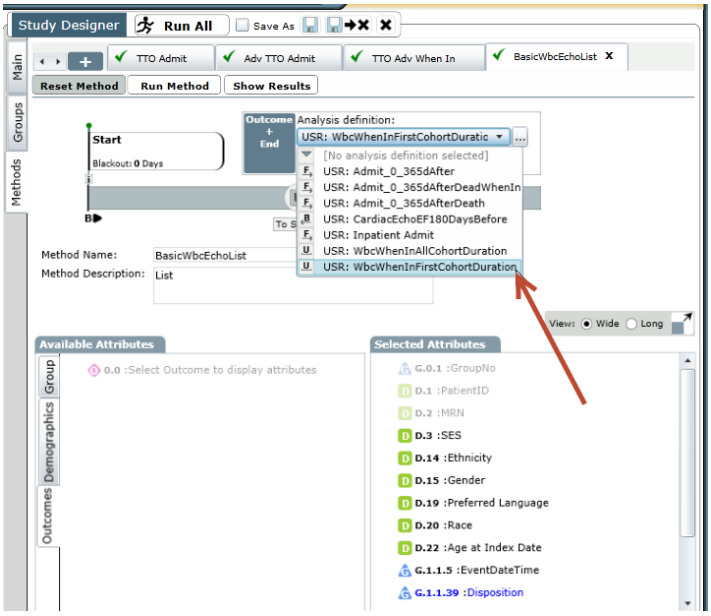
We want to add a column of white blood cell counts to our list using the Analysis Definition we’ve just built.

We need to add the Analysis Definition “WbcWhenInFirstCohortDuration” to our Advanced mode racetrack.

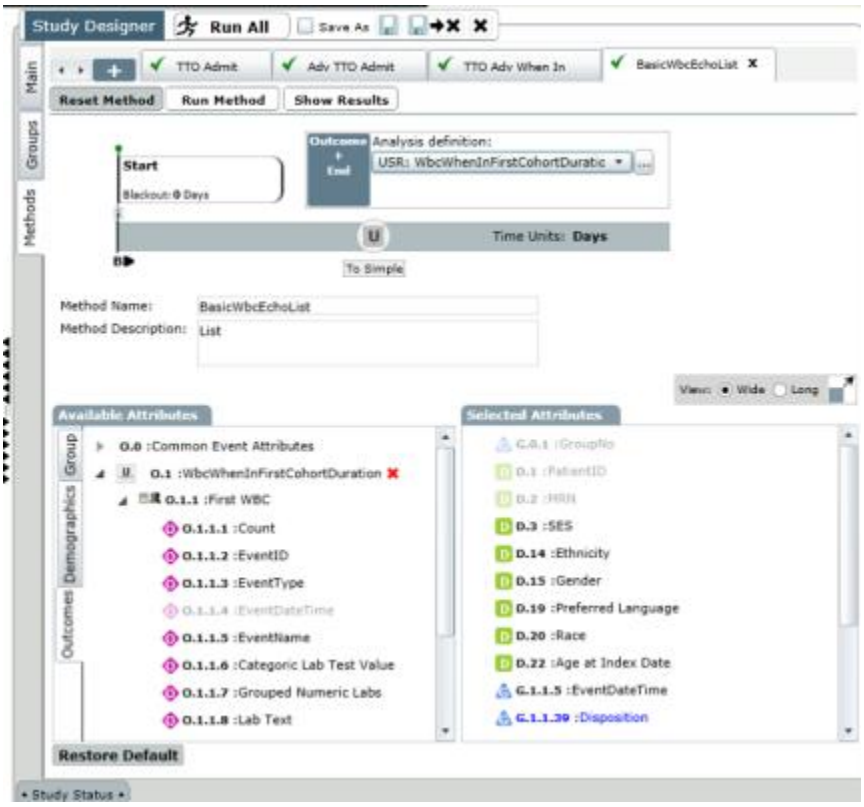
When we do that, all the attributes of the added Analysis Definition will appear in the Outcomes tab of the “Available Attributes” and we will be able to select White Blood Count.

Hover over the dropdown menu and choose “WbcWhenInFirstCohortDuration”.

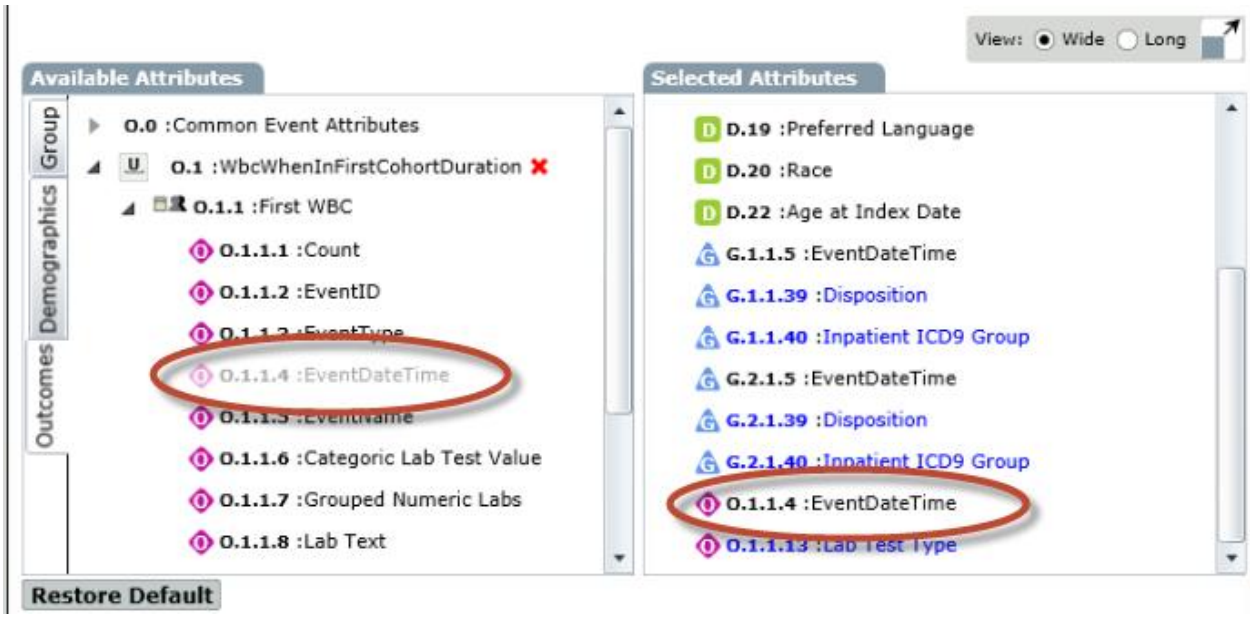
> Note, when you first build an Analysis Definition you will find it at the bottom of the dropdown list. In the future you will find it alphabetically arranged.



Resulting in:



Note “EventDateTime” in Available Attributes for the White Count AD is grayed out, meaning that we should expect to find it under Selected Attributes when we move the vertical slider.



We want to drag Lab Test Value and Count.

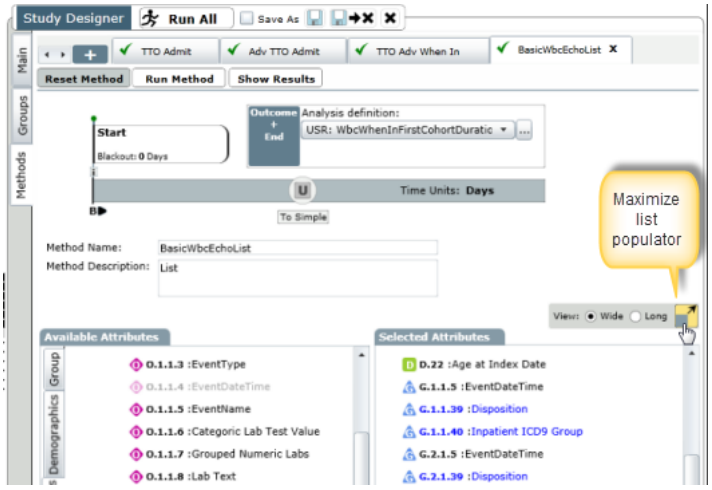
Lab test value will provide the actual White Blood cell count.

Count will provide an indicator variable for the count of results.

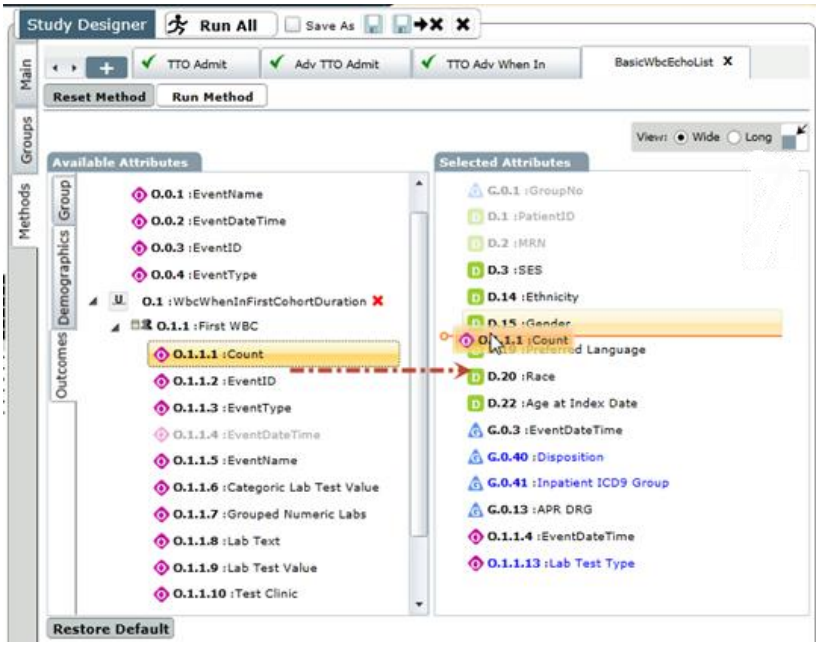
Since in this case we are looking for earliest, count will be either 0 or 1.

Since in this case count is referring to a singularity, a count will be either 0 or 1.

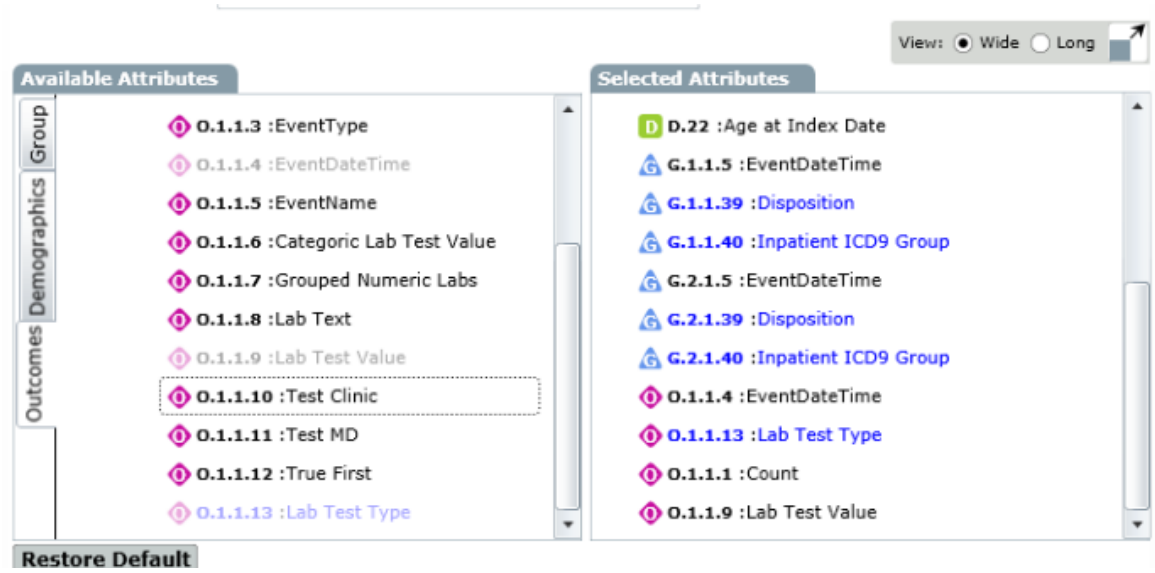
Maximize the list populator.



Drag over Count and Lab Test Value from “Available Attributes” into “Selected Attributes”



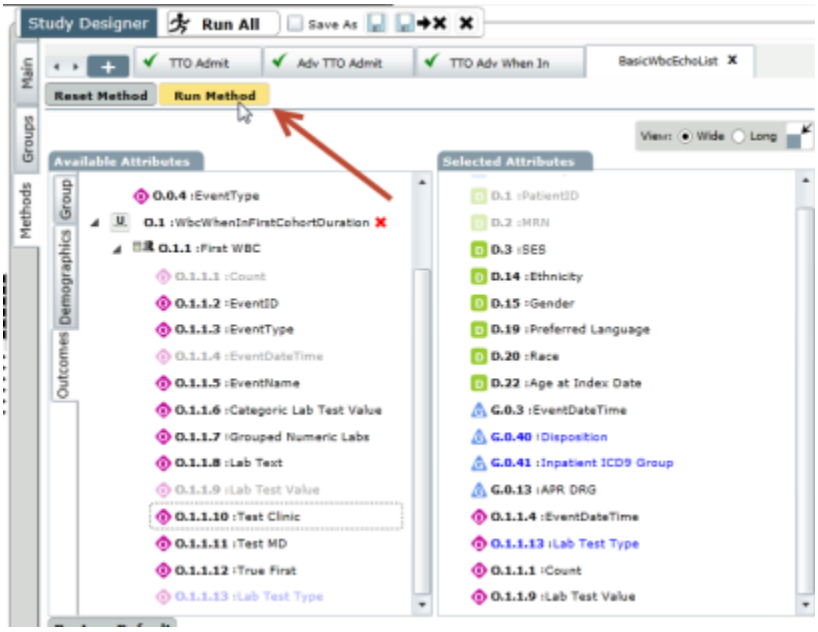
This results in:



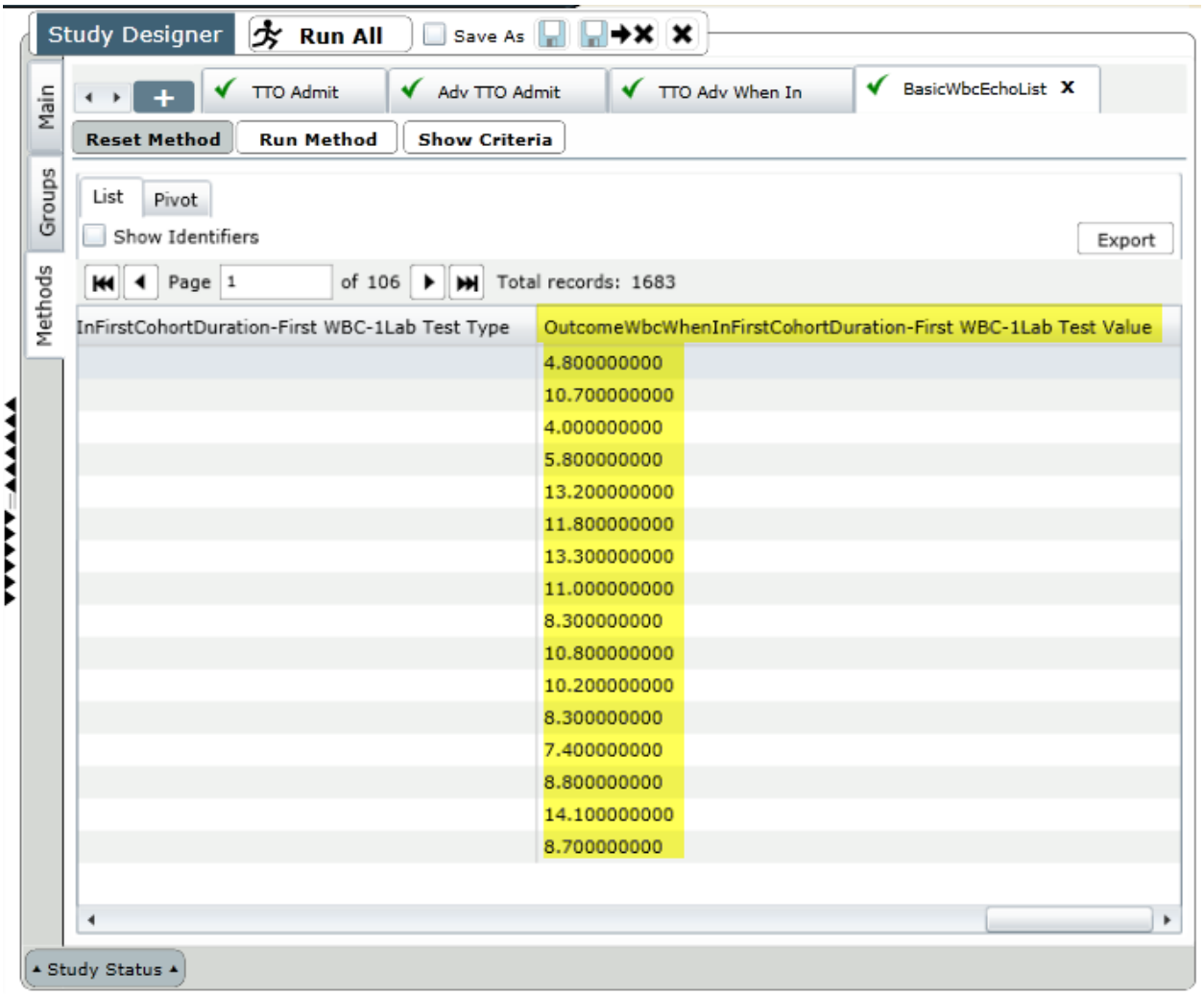
Notice that “Lab Test Value” in “Available Attributes” is grayed out.

“Lab Test Value” is visible in “Selected Attributes”.

Run the Method:



Save.



The spreadsheet we generated first included APR DRG and disposition from the cohort's index event.

We have just added the White Blood Counts and Lab Test Values during the hospitalization.

Now we want to add the latest Cardiac Echo ejection fraction in the 180 days before the patient's discharge (cohort index event).

Let's build the analysis definition to find the Cardiac Echo ejection fraction:

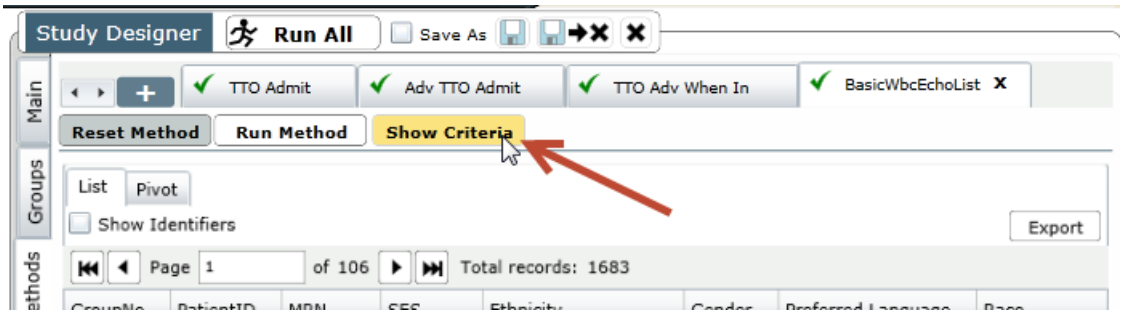
To get the echo ejection fraction you must get the echo event which is known as EchoDate.

> To find relevant event types like cardiac echo, go to the Event Manual 3 v2.6, stored within your Box link. Use the find (Ctrl +F) capability of Adobe Reader to search for the words cardiac echo.

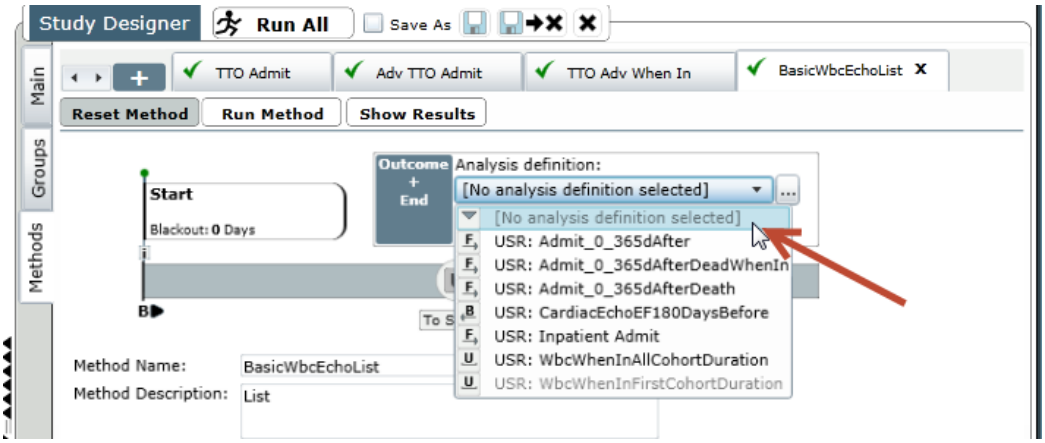
Or alternatively, do something novel and read the table of contents in the Event Manual 3 v2.6 where you can find event types.

Let's return to Study Designer "Show Criteria" page.

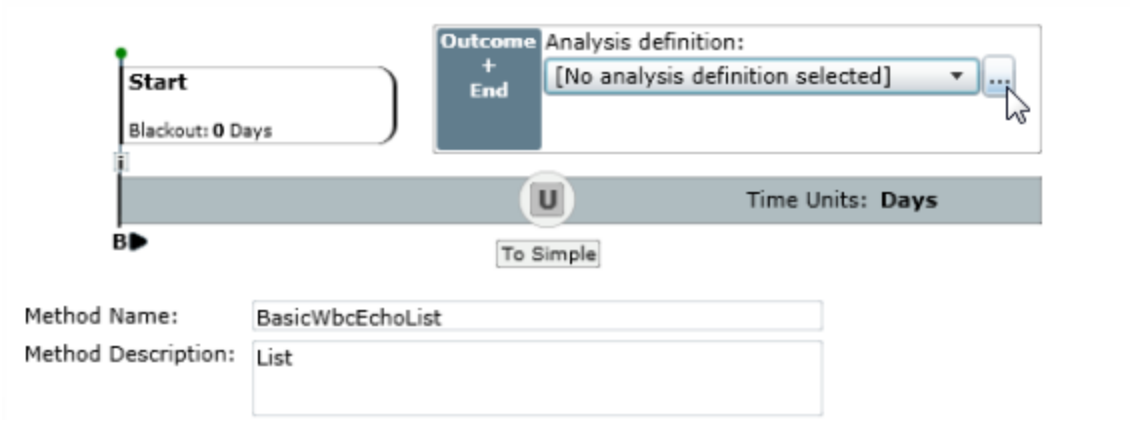
Hover over "Show Criteria" and left click.



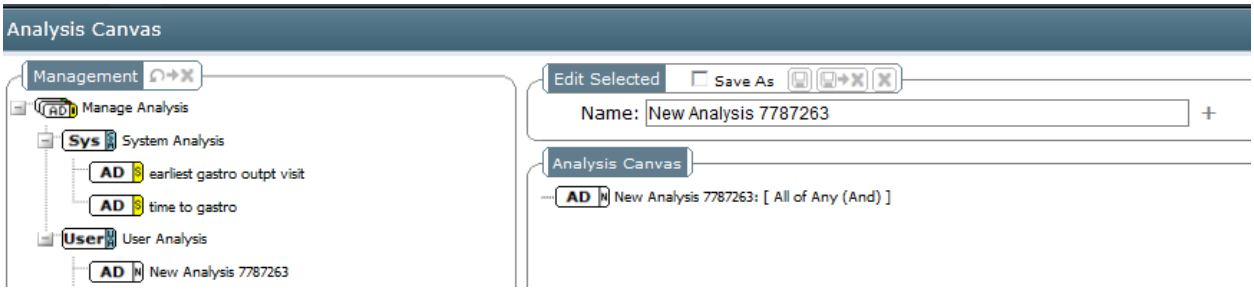
Left click on the Analysis Definition and choose "[No analysis definition selected]"



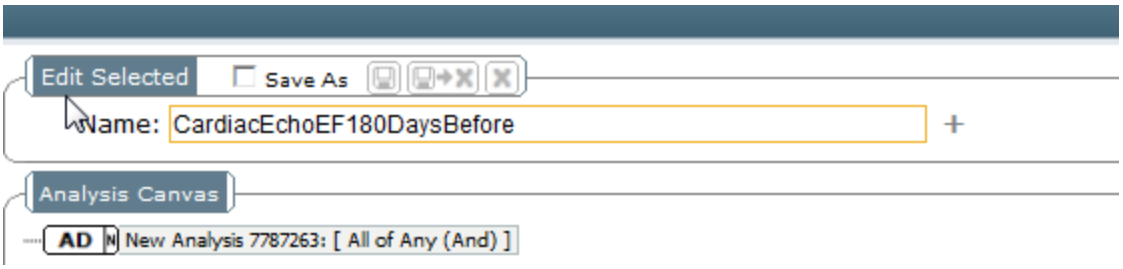
Open the canvas using the triple dotted button.



A new Analysis Canvas opens.

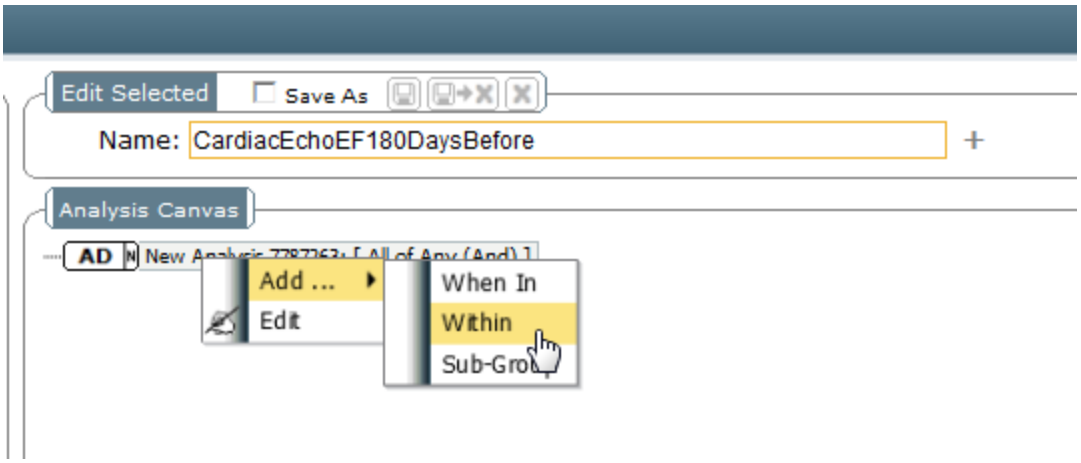


Name your Analysis Definition “CardiacEchoEF180DaysBefore”



We are interested in the Cardiac Echo Ejection Fraction’s that occurred before the inpatient discharge. We require the cardiac echo to have occurred within 0-180 days prior to the cohort index date. Therefore, we need a “Within” condition.

Right click on New Analysis and Add “Within”.

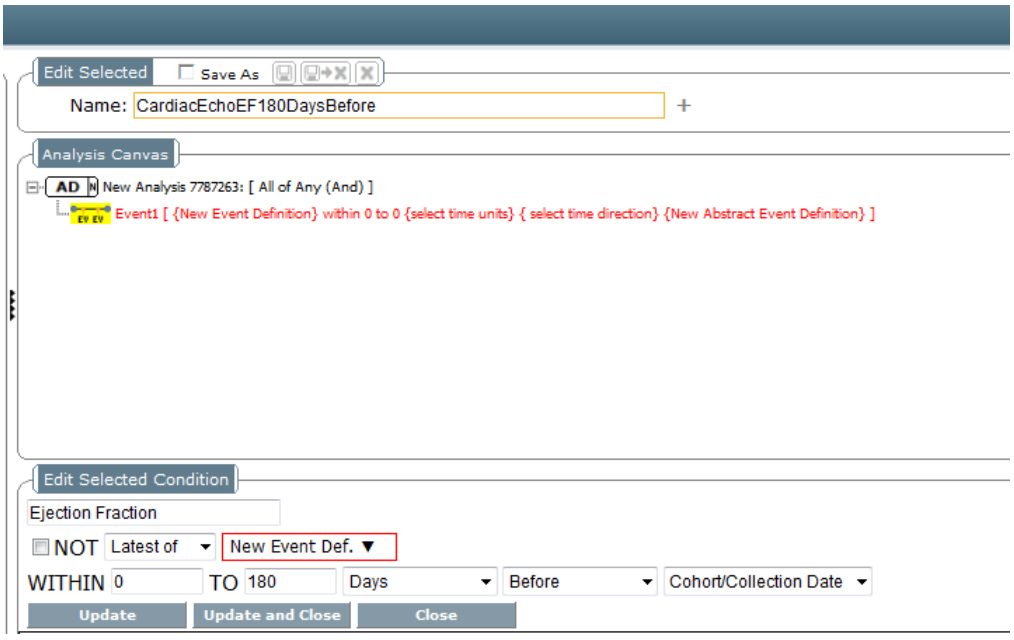


A new condition line will appear.

We need to find the **latest** Echo for each patient 0-180 before the index discharge.

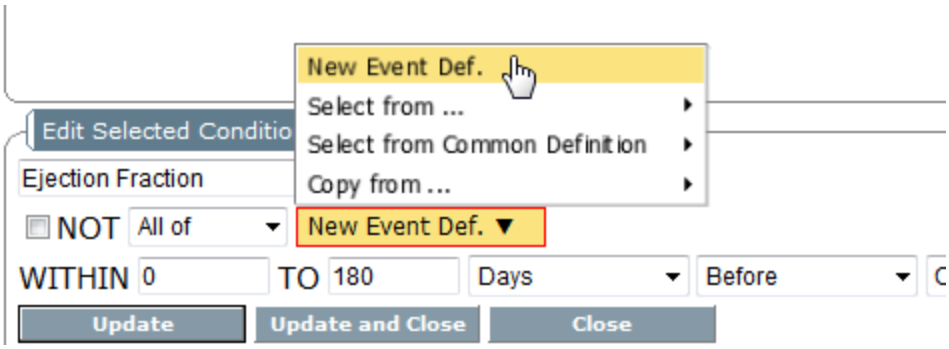
In the Gui editor below, change “All of” to “Latest of”.

Specify the timeframe: 0-180 days “Before” the “Cohort/Collection Date”

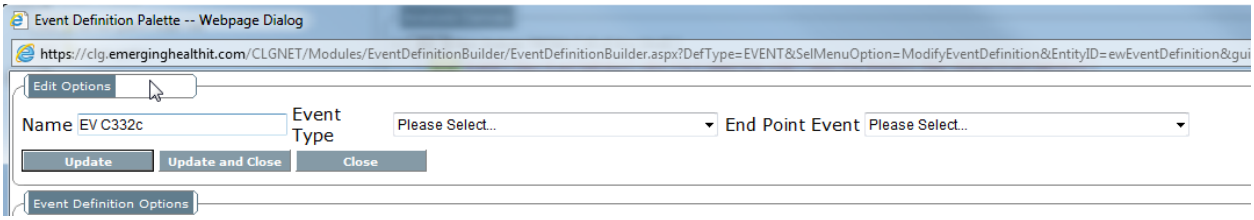


Create a new event definition for the Cardiac Echo.

Hover over “New Event Definition” and left click.

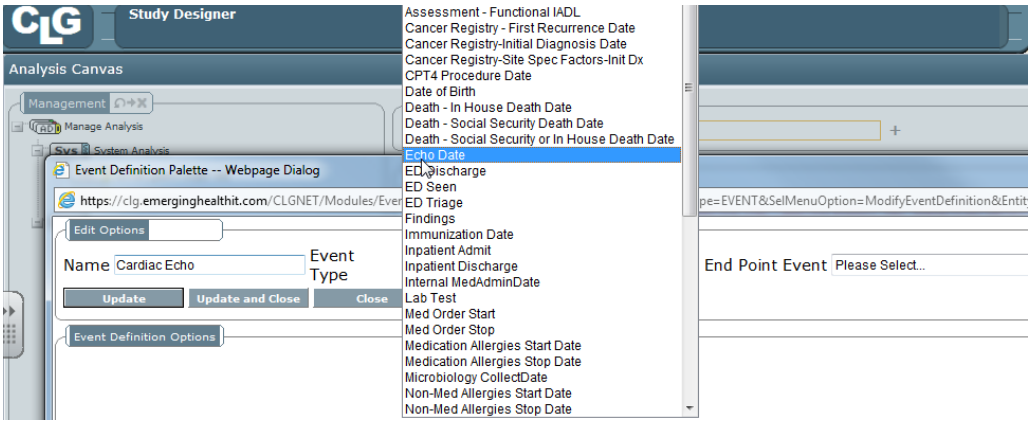


A blank definition palette appears.

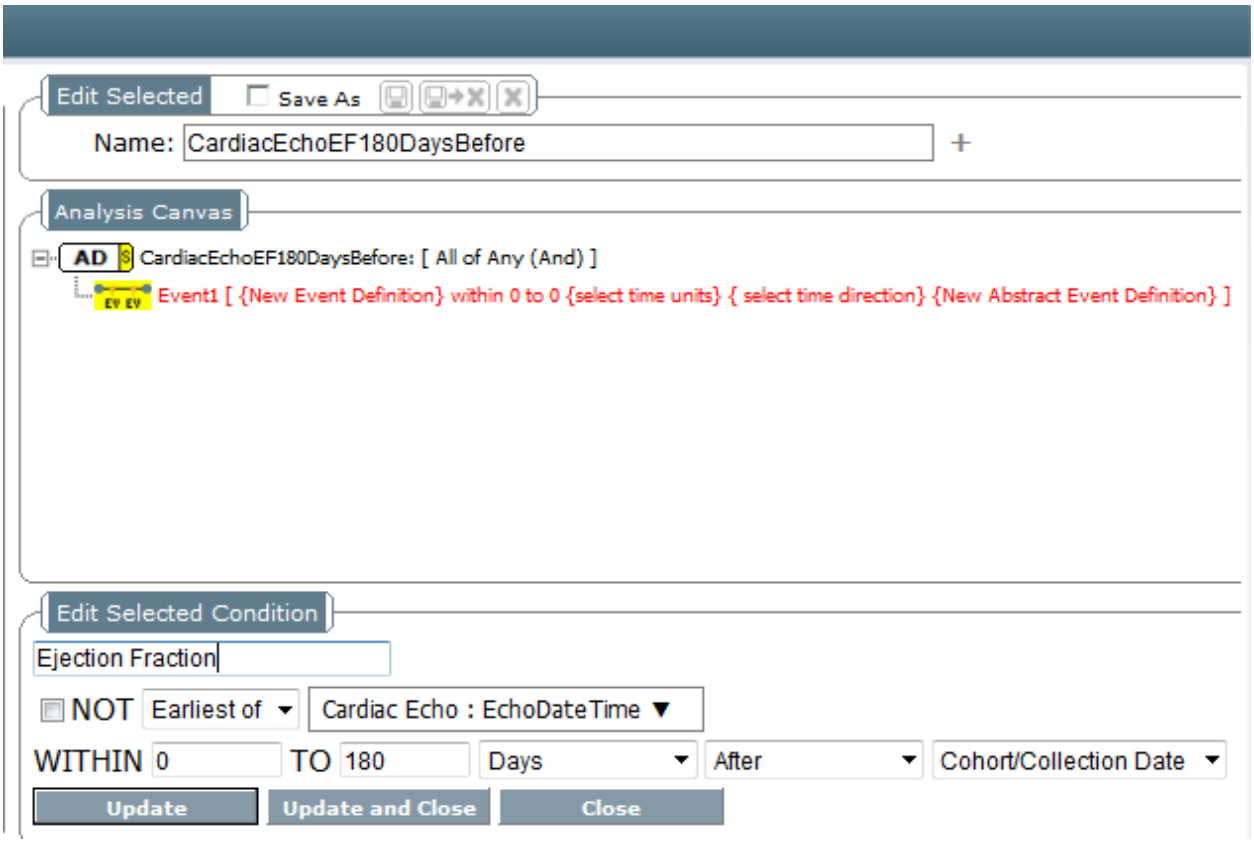


Name the definition “Cardiac Echo”

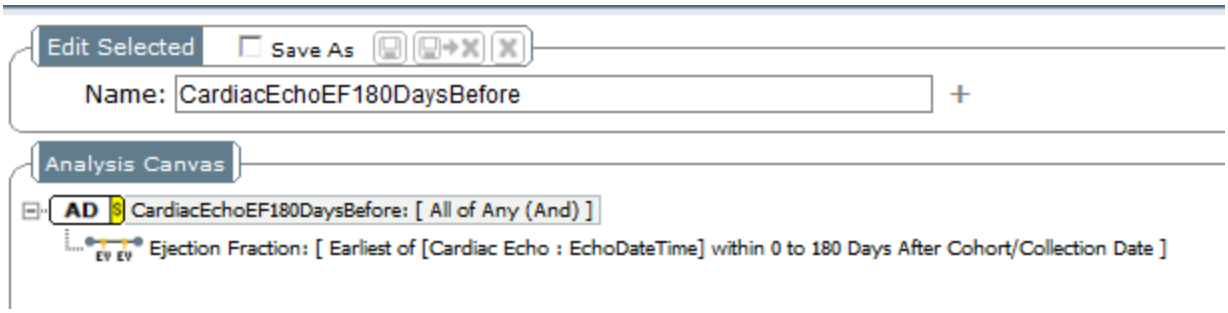
Choose “Echo Date” from the Event Type drop down menu



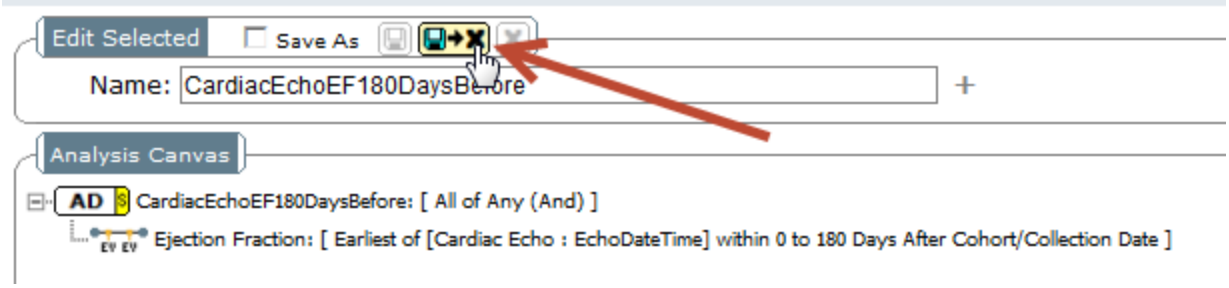
Update and Close



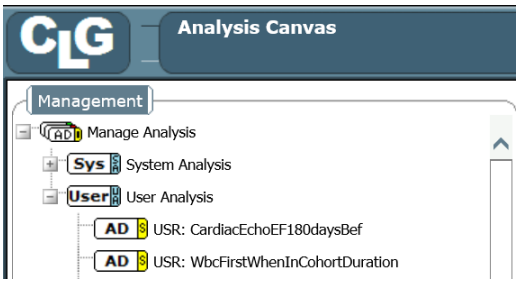
Update and close


Edit Selected
Save As
Name: CardiacEchoEF180DaysBefore
Analysis Canvas
AD
CardiacEchoEF180DaysBefore: [All of Any (And)]
Ejection Fraction: [Earliest of [Cardiac Echo : EchoDateTime] within 0 to 180 Days After Cohort/Collection Date]

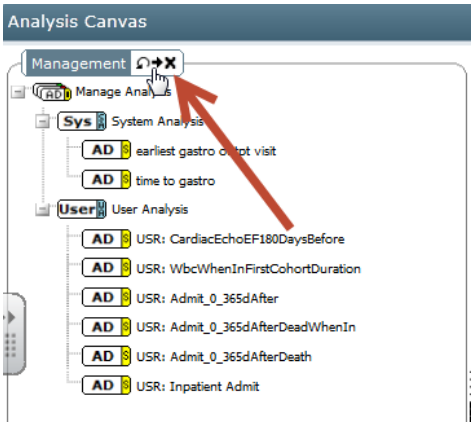
Save and Exit


Edit Selected
Save As
Name: CardiacEchoEF180DaysBefore
Analysis Canvas
AD CardiacEchoEF180DaysBefore: [All of Any (And)]
Ejection Fraction: [Earliest of [Cardiac Echo : EchoDateTime] within 0 to 180 Days After Cohort/Collection Date]

View in the management pane the new AD called "USR: CardiacEcho180daysBef".

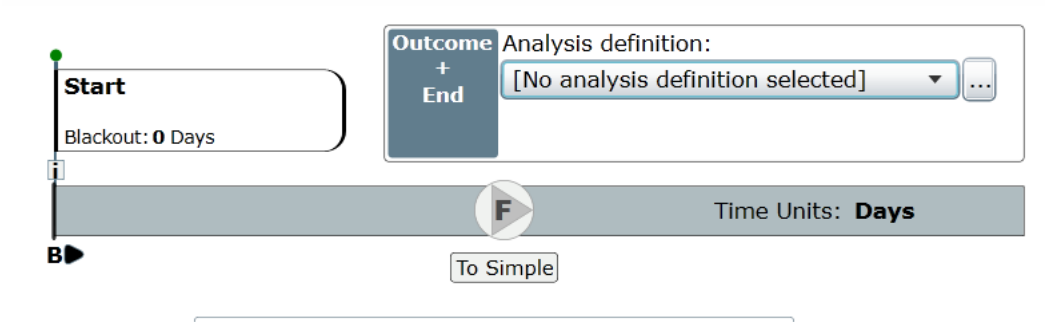


Now exit to return to Study Designer criteria page.



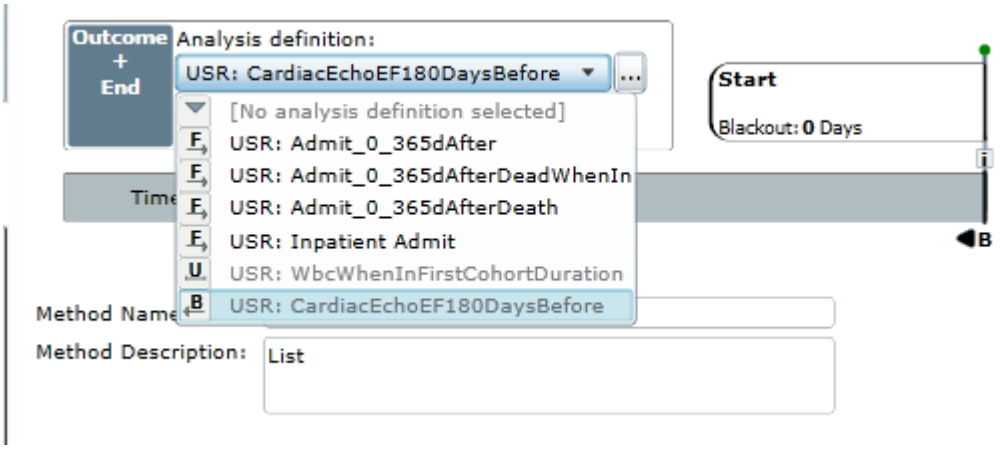
From Analysis Definition dropdown menu choose “CardiacEchoEF180DaysBef”.

You have the racetrack paradigm exposed.

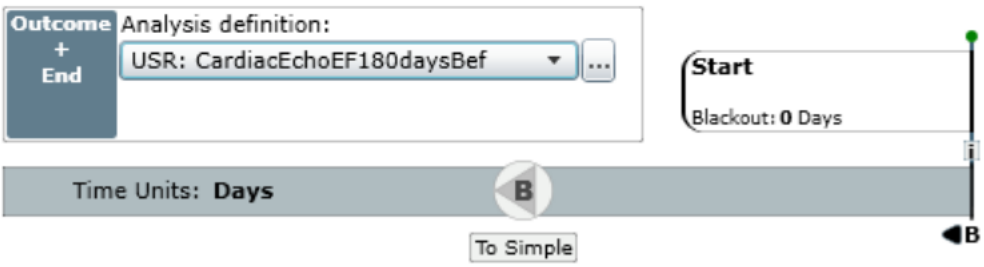


Add the Analysis Definition by clicking on the black downward arrow and left clicking.

After choosing the Echo we note the following:

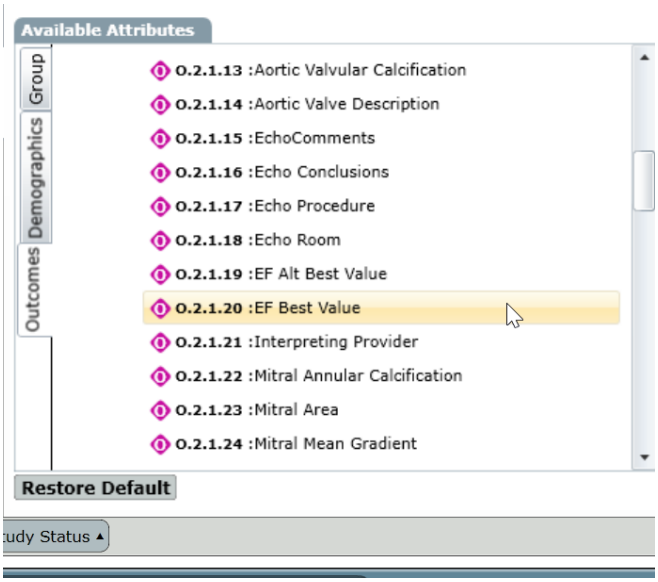


Notice how the Outcome+End flag (Analysis Definition) moved to the left. This is a result of the fact that the AD is **before** the index date time.

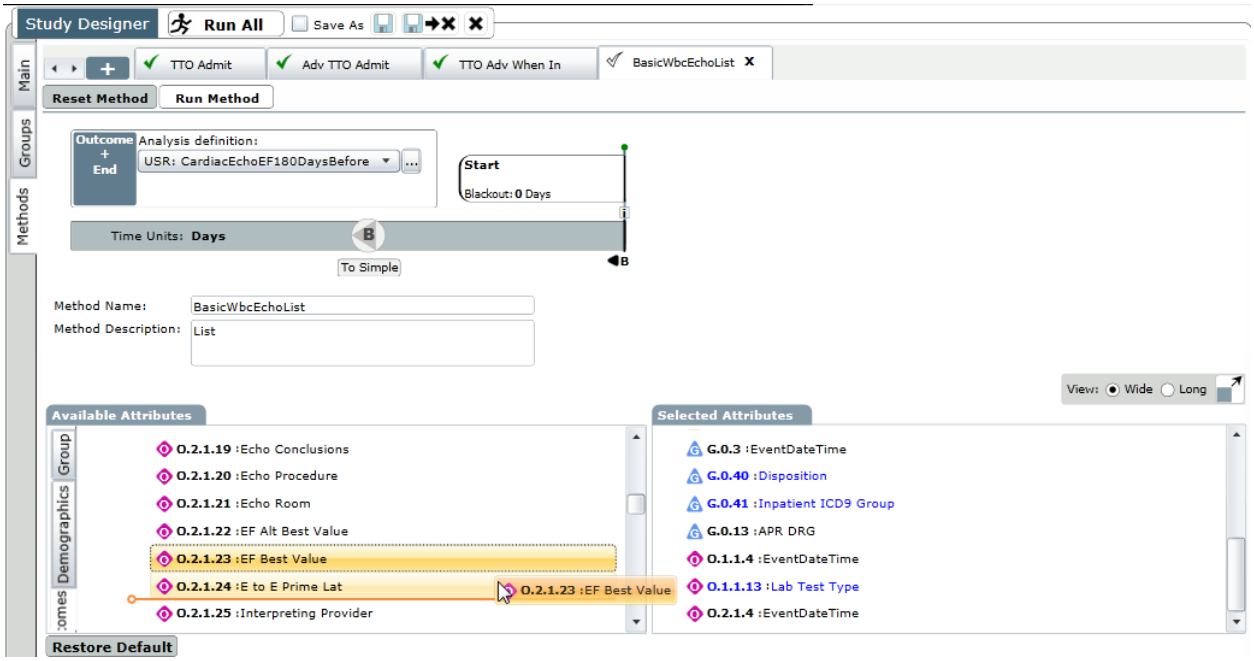


Maximize the list by left clicking on **"List populator Maximizer"**

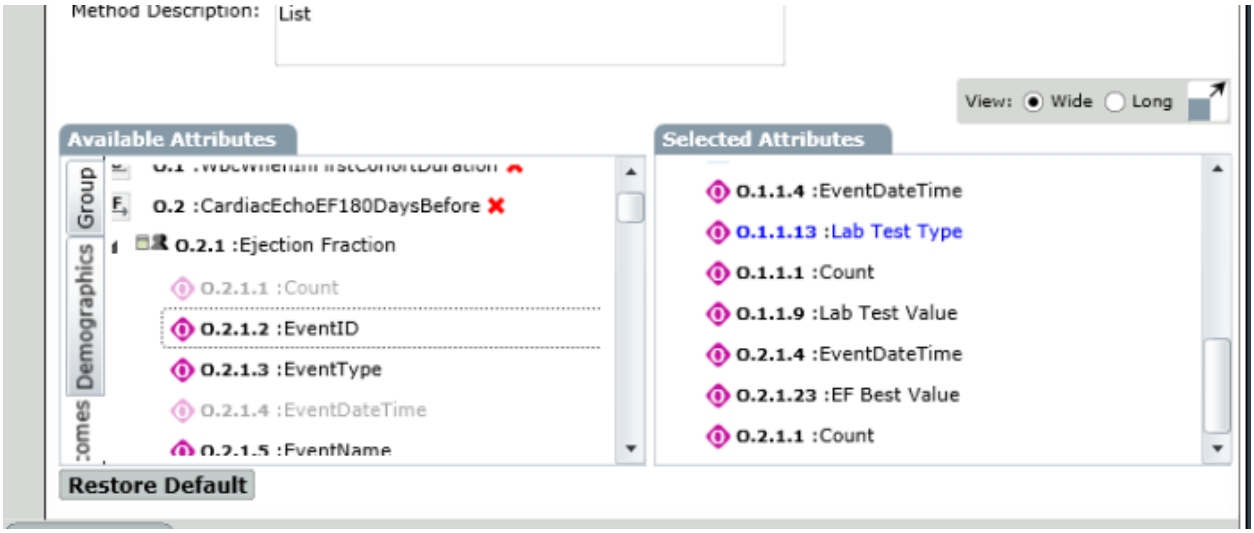
Move the window slider down until you see Best Value Ejection Fraction:



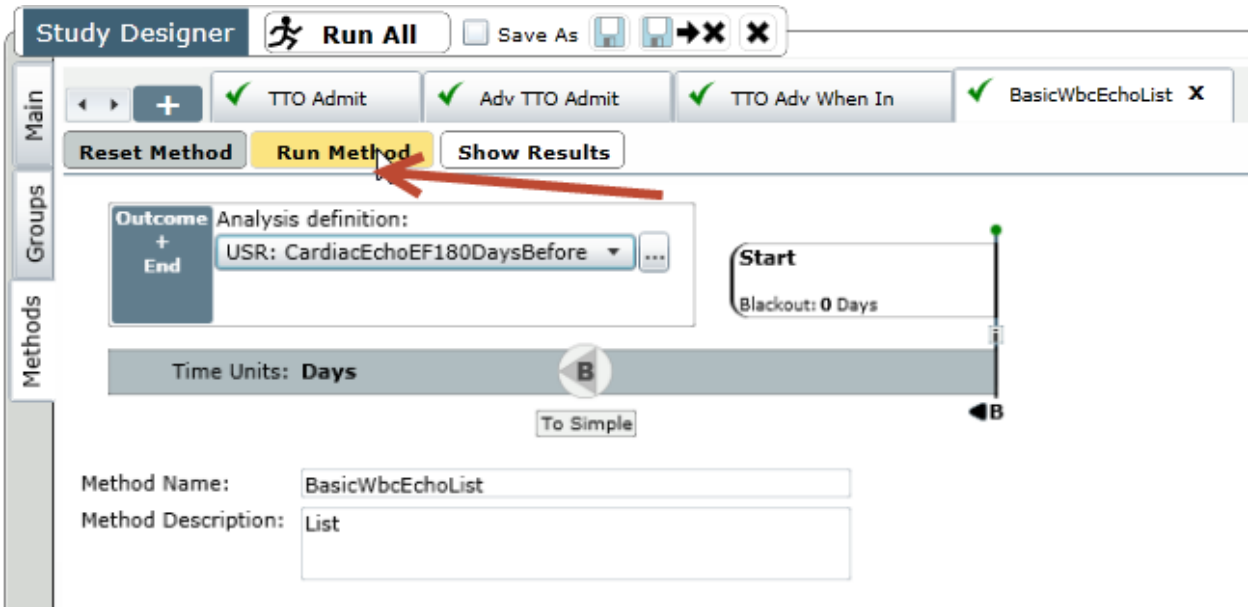
Now drag both Count and EF Best Value to the “Selected Attribute” Section.



Resulting in:

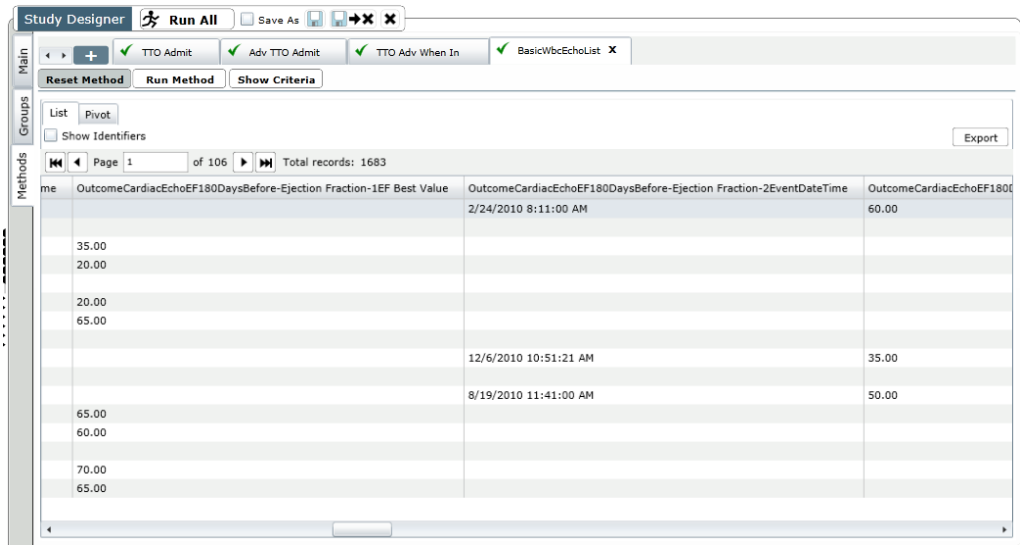


Now run “BasicWbcEchoList”



Save

View Results



All cohort members are represented with a row. You will note that some rows have no ejection fraction. Those without an echo are left blank on the outcome for Ejection fraction.

List Method asking for **all** results not just the earliest or last

Tutorial 24: List Method Long view

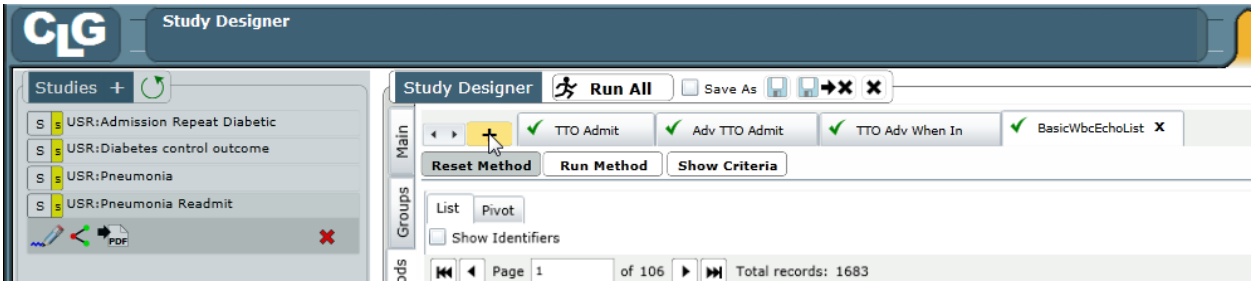
https://www.youtube.com/watch?v=hZegDjKyXzI&list=PLf7raPnmlLOeAWU2cNf2jIMDRqQuUTCum&index=24

Until now, our ADs were “singularities” requesting the earliest or latest event.

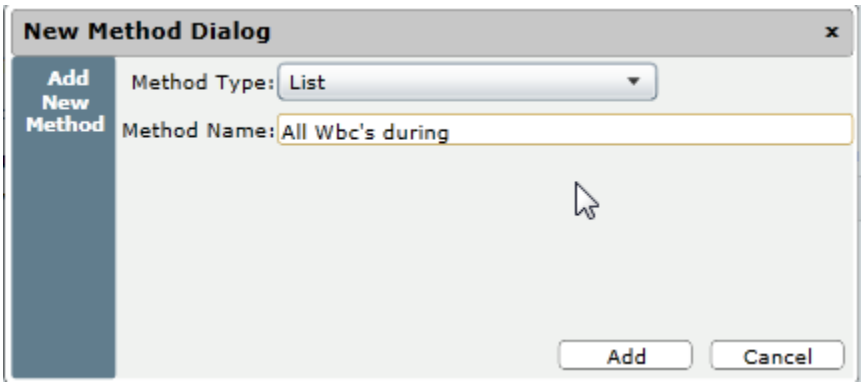
Suppose you want to build an AD with All, for example you are interested in All the Wbc in a patient with a pneumonia admission, not just their first or latest Wbc.

To save time we will modify an old Analysis Definition, and save it with a new name.

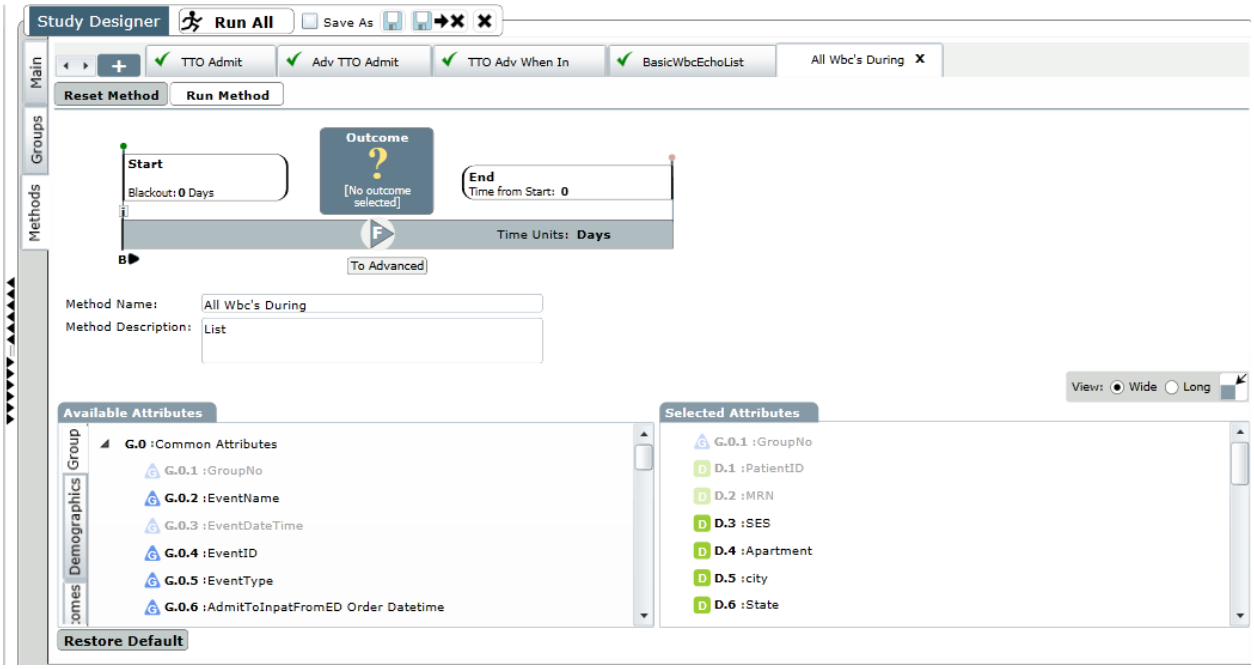
First add a new study method by left clicking on the + sign.



Select “List” as the Method Type and name the method “All Wbc’s during”

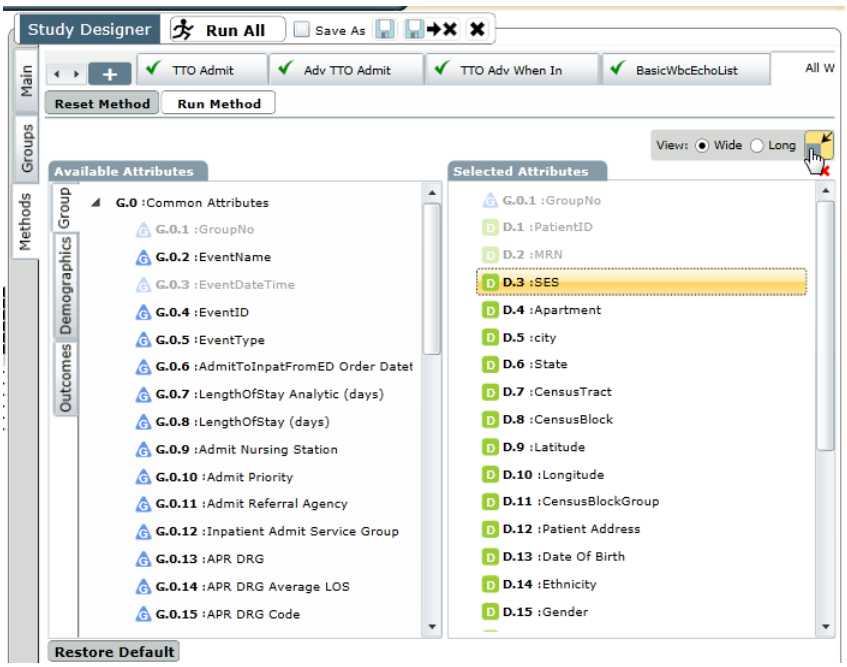


Click Add

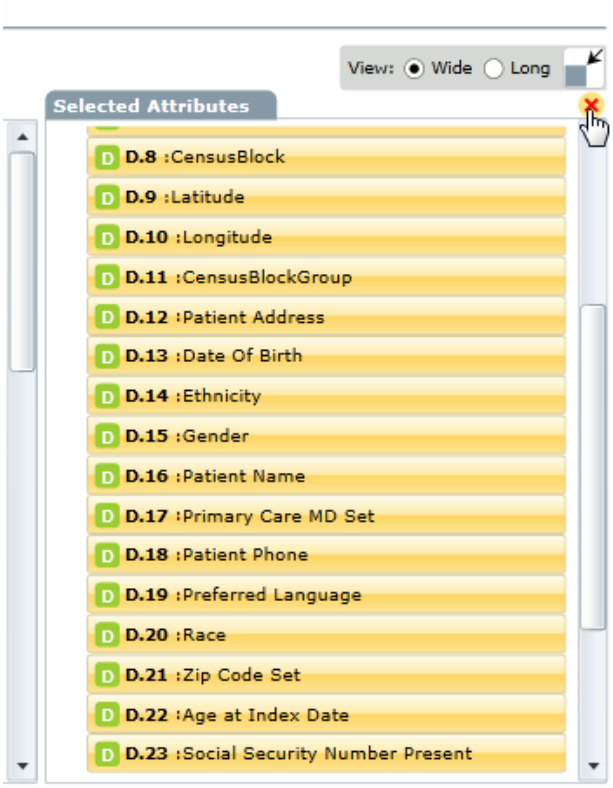


To simplify this exercise, we are going to delete all of the "Selected Attributes" chosen by default by Looking Glass.

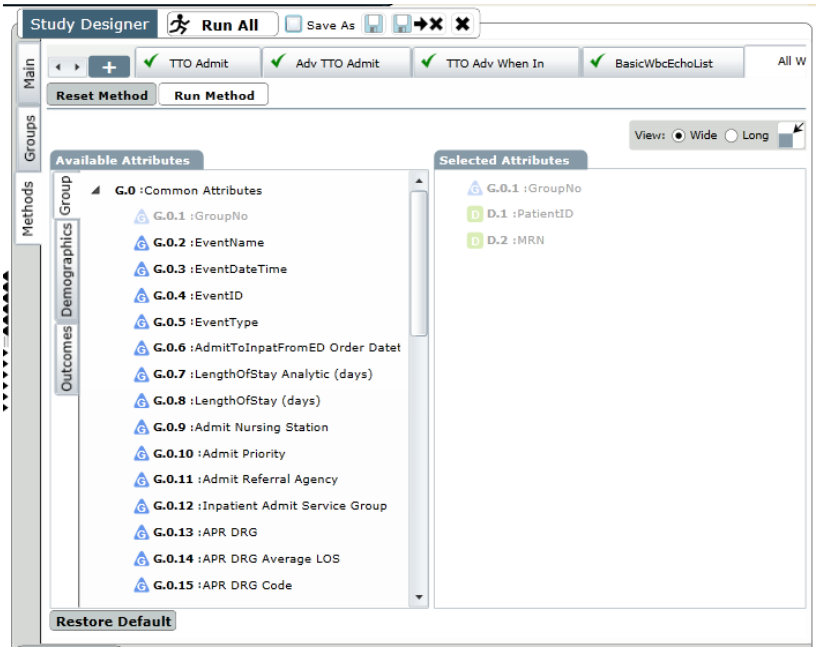
Click on the list populator maximizer.



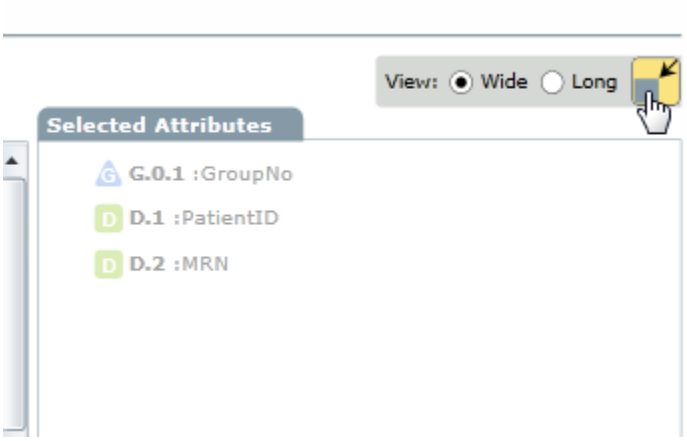
Highlight all “Selected Attributes” and delete



The only attributes that remain are those required by the system.



Minimize the list populator by clicking on the list maximize toggle switch.

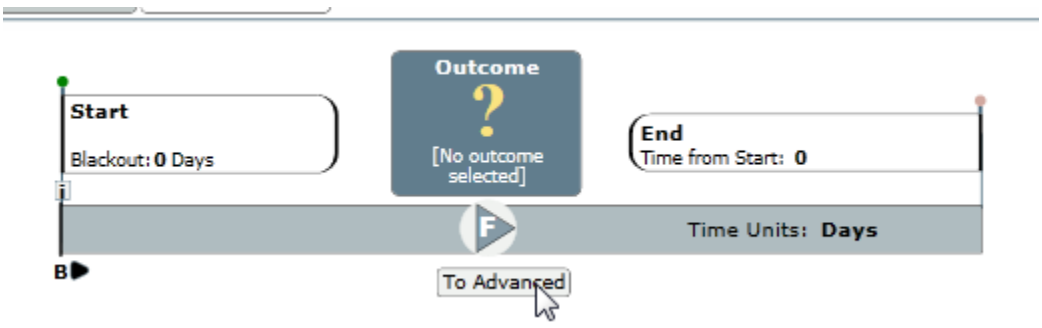


The Simple method assumes that we are only looking for a single value.

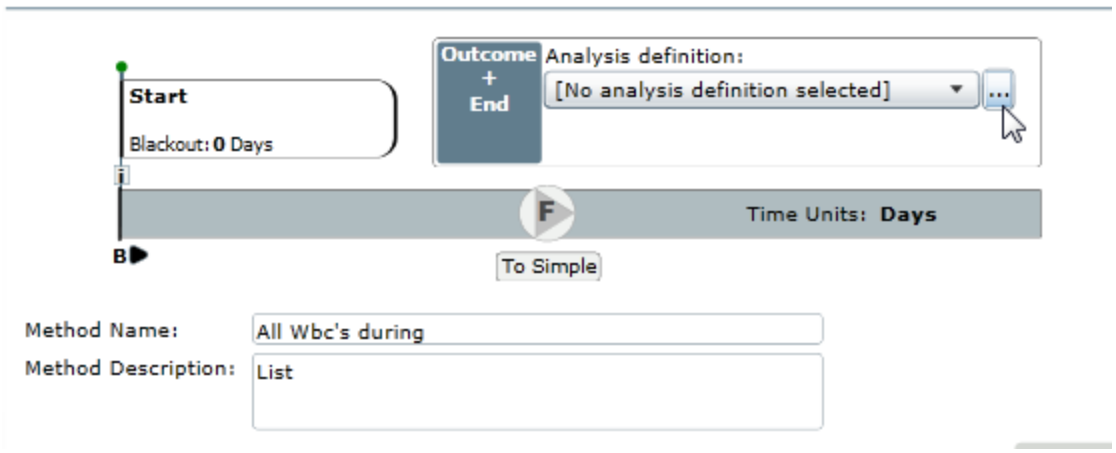
To obtain “All” Wbc’s, we need to go to the Advanced method and build an Analysis Definition.

We will go to the Advanced method and modify a previously built Analysis Definition.

Hover over “To Advanced” and left click to move to the Advanced mode.



Choose from the Analysis Definition dropdown “[No analysis definition selected]” and left click on the triple dotted button.



An Analysis Definition skeleton appears on the Analysis Canvas.

We are going to exit the Analysis Definition canvas,

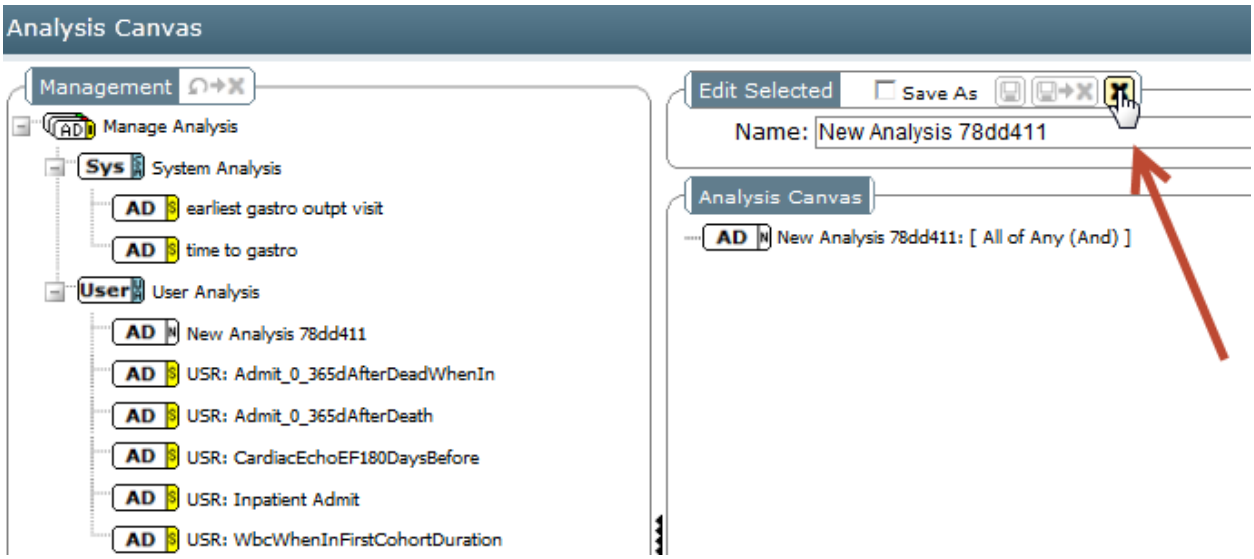
go to management pane of the Analysis canvas

remove the skeleton

edit a previously built AD

and save the newly created AD with a new name.

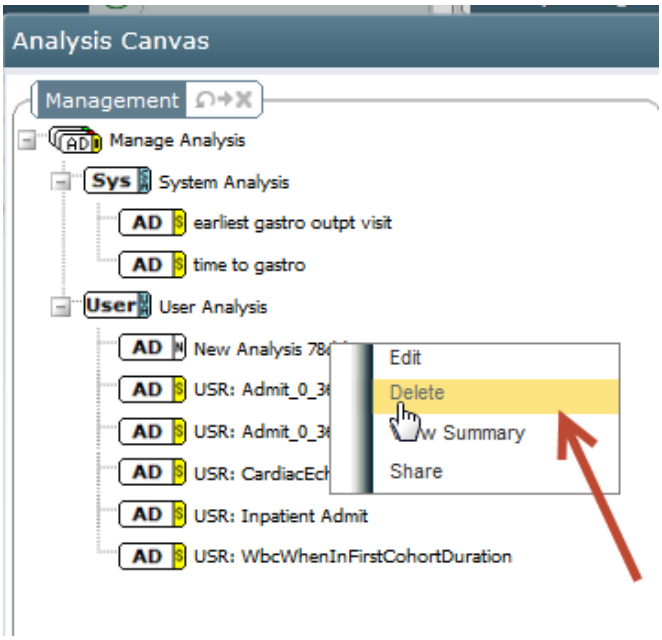
Click on the X.



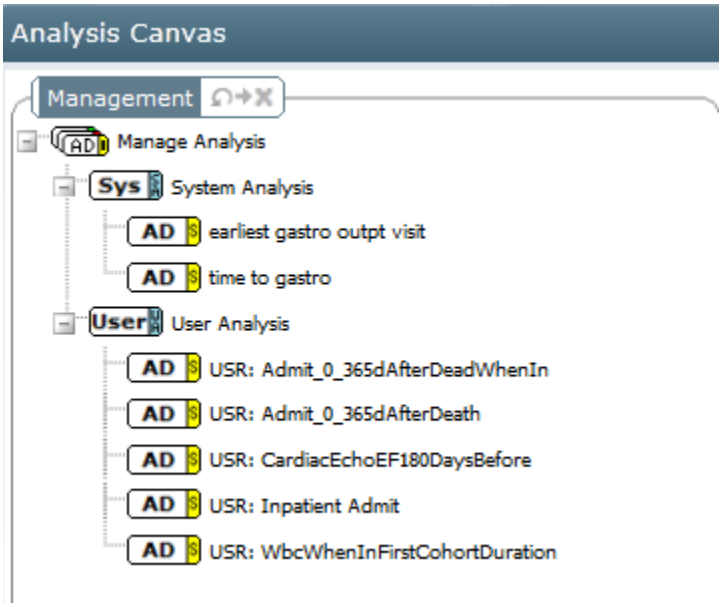
The canvas now looks like this:

Hover over the new analysis definition (in our case “New Analysis 78dd411” yours will be different) and right click.

Delete the new analysis definition.

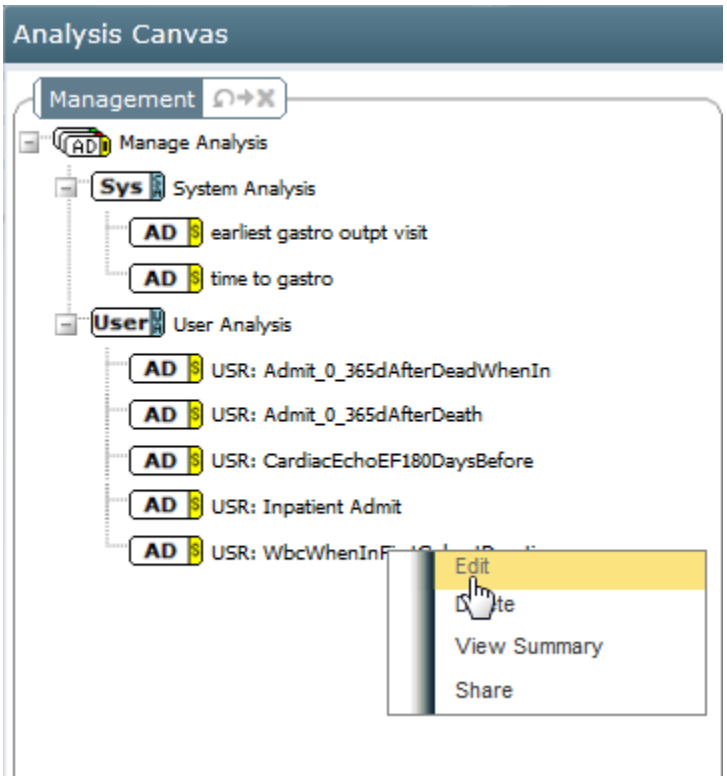


Now it's gone.

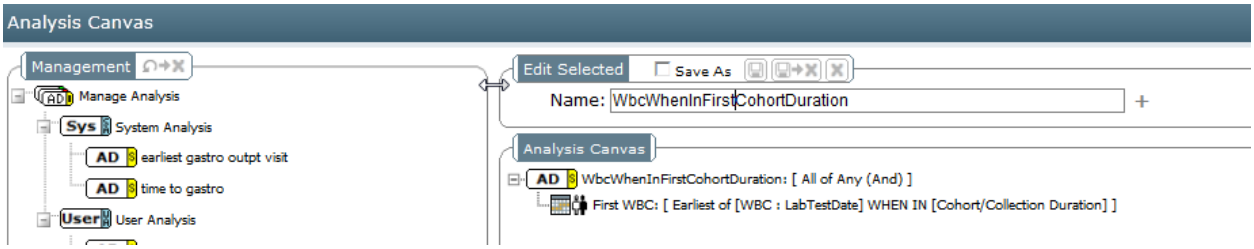


We will modify "WbcWhenInFirstCohortDuration" changing it from "First" to "All".

Right click on "WbcWhenInFirstCohortDuration" and "Edit".



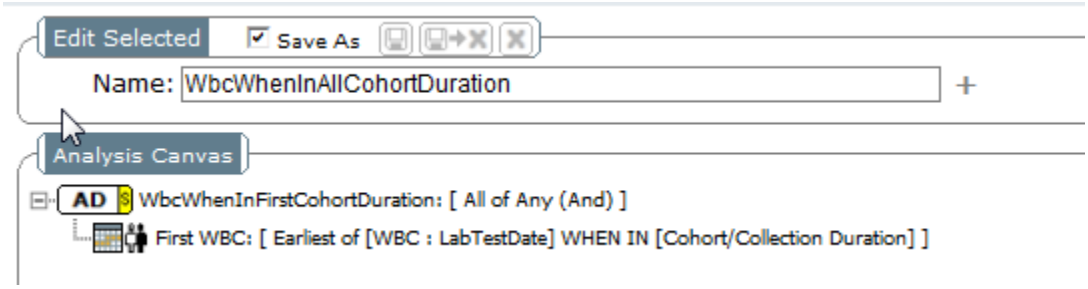
Resulting in:



The first order of business is to prevent the overwriting of your previously built Analysis Definition.

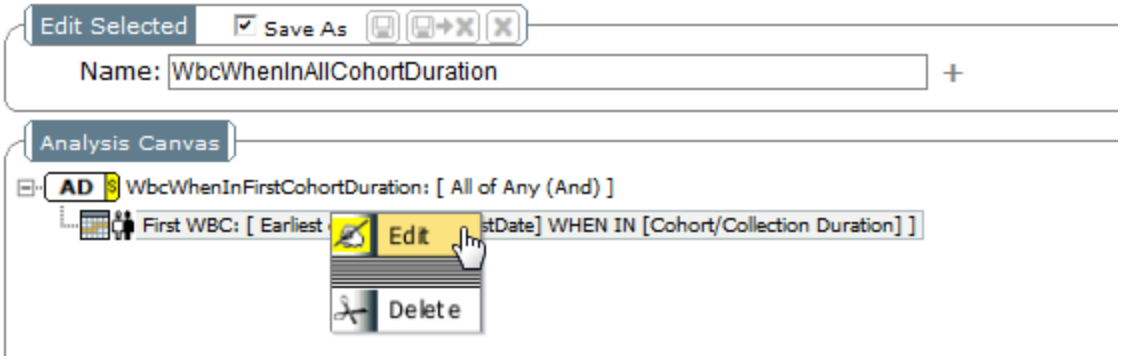
To do this, you will change the name and check off “Save As”.

Check off “Save As” and change the name to “WbcWhenInAllCohortDuration”


Edit Selected
Save As
Name: WbcWhenInAllCohortDuration
Analysis Canvas
AD
WbcWhenInFirstCohortDuration: [All of Any (And)]
First WBC: [Earliest of [WBC : LabTestDate] WHEN IN [Cohort/Collection Duration]]

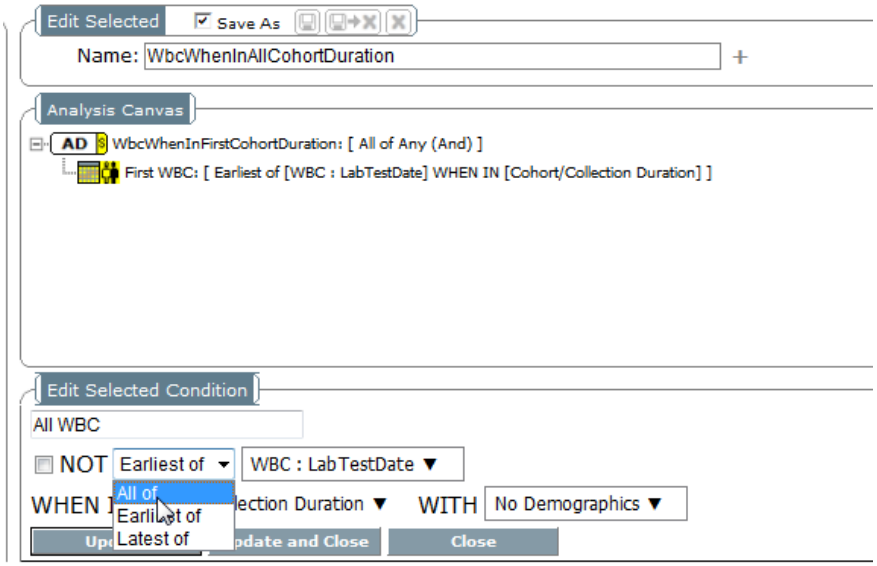
Right click on the “First Wbc” condition line to open the menu.

Right click on “Edit”

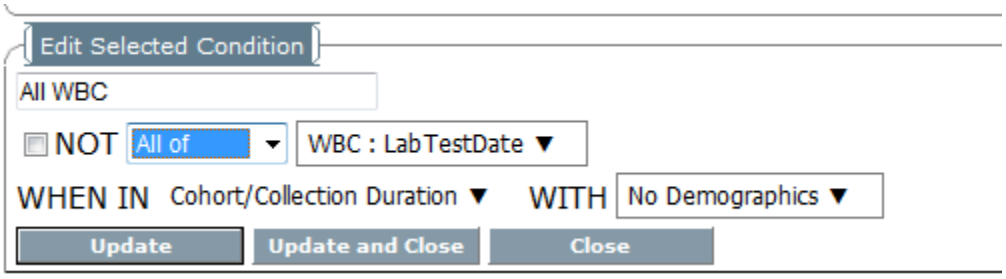


In the Gui editor below, change the name to “All WBC”

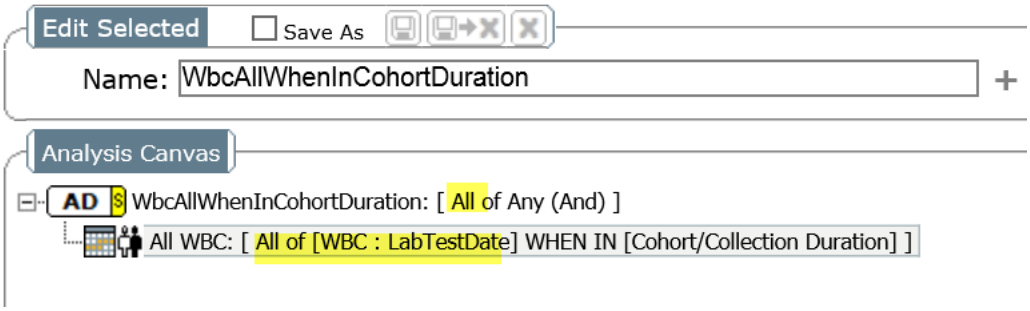
Change “Earliest of” to “All of”



Resulting in:

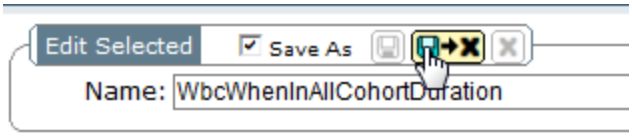


Update and Close and the AD looks like this:

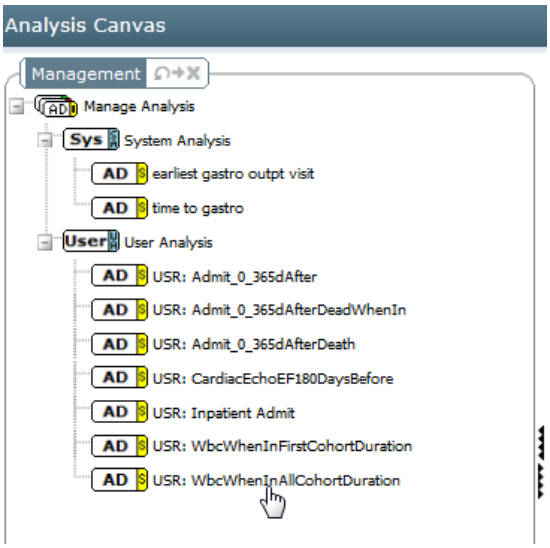

Edit Selected
Save As
Name: WbcAllWhenInCohortDuration
Analysis Canvas
AD
WbcAllWhenInCohortDuration: [All of Any (And)]
All WBC: [All of [WBC : LabTestDate] WHEN IN [Cohort/Collection Duration]]

Notice the **All** on both the Index Event Line and on the first condition line.

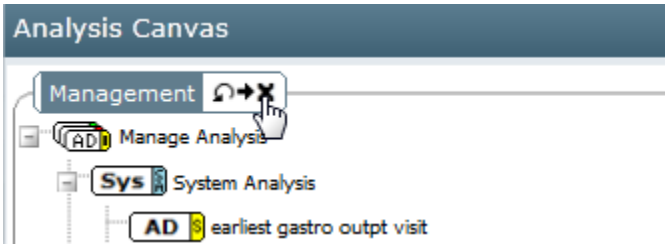
Save and close



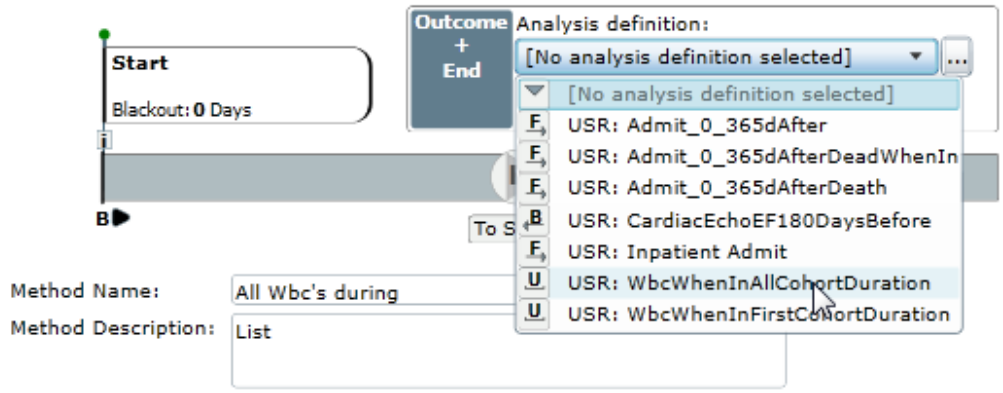
The new AD appears in the management pane.



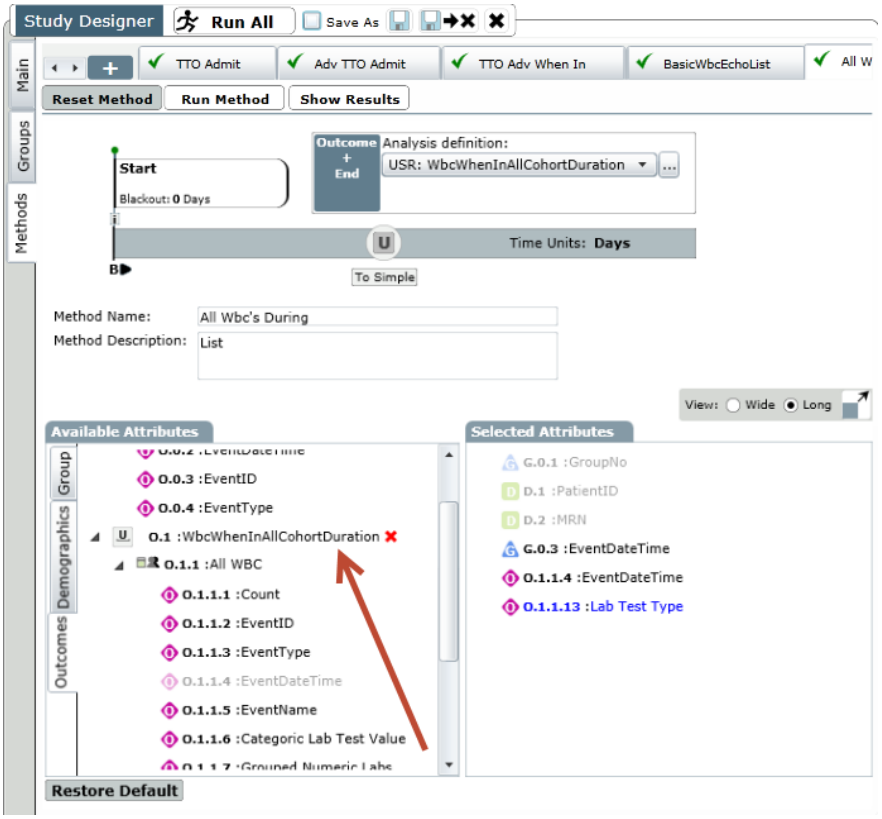
Exit and return to Study Designer



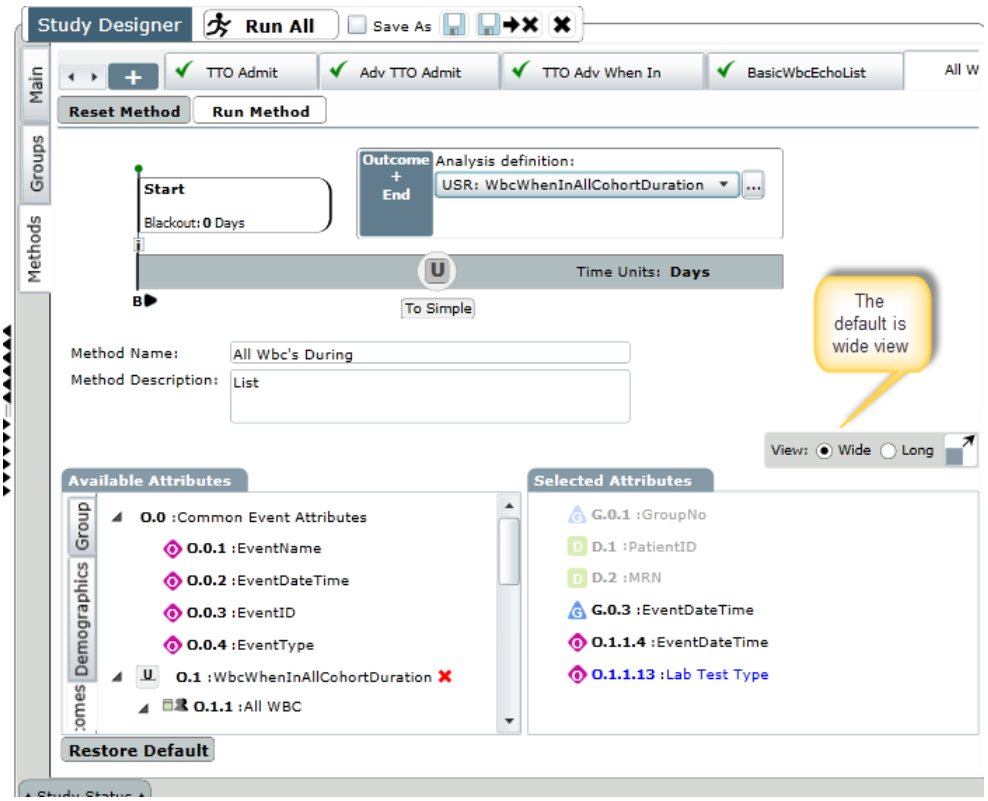
Choose the Analysis Definition “WbcAllWhenInCohortDuration” from the drop down menu.

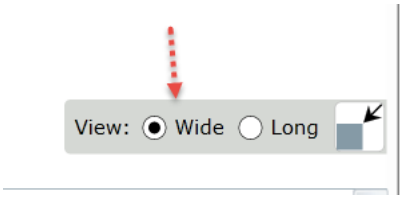


Now the outcomes tab in the “Available Attributes” of the list populator has “All Wbc”.

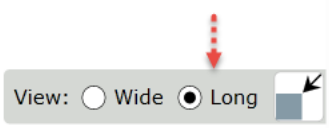


The default is wide view:





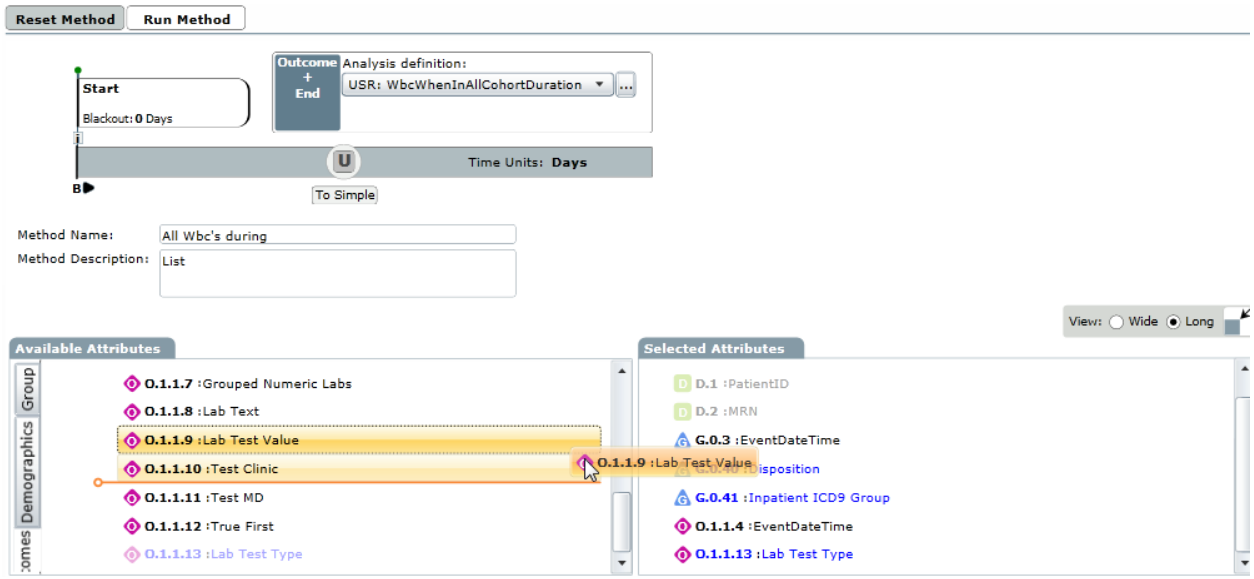
The default Wide view will create a separate column for each wbc for each patient. If even one of the patient's in the cohort had 100 wbc tests then you would have 100 columns for wbc values and 100 columns for event date for every patient. Even if the next patient in the cohort had only one WBC, he would also have 100 columns although the other 99 would be blank. Creating such wide spreadsheets stresses CLG a great deal so when you have "all" as your target outcome, you should use Long View instead of wide view. It also makes the data unmanageable.



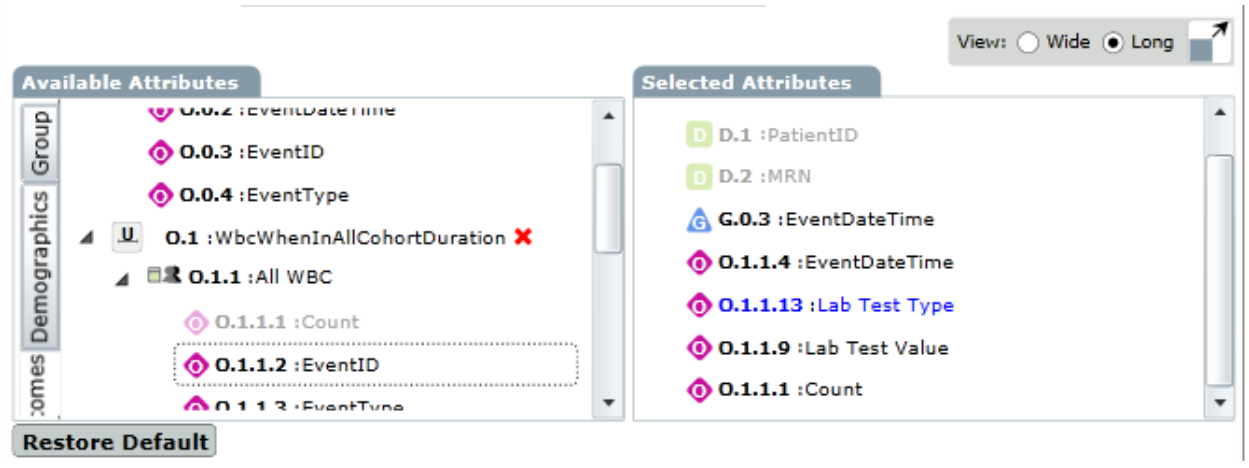
In the long view, there will be individual rows for each wbc for each patient.

The patient with 100 wbc's would have 100 rows repeating his medical record number, but each row would have a different wbc value.

Drag "Lab Test Value" and "Count" from "Available Attributes" to "Selected Attributes"



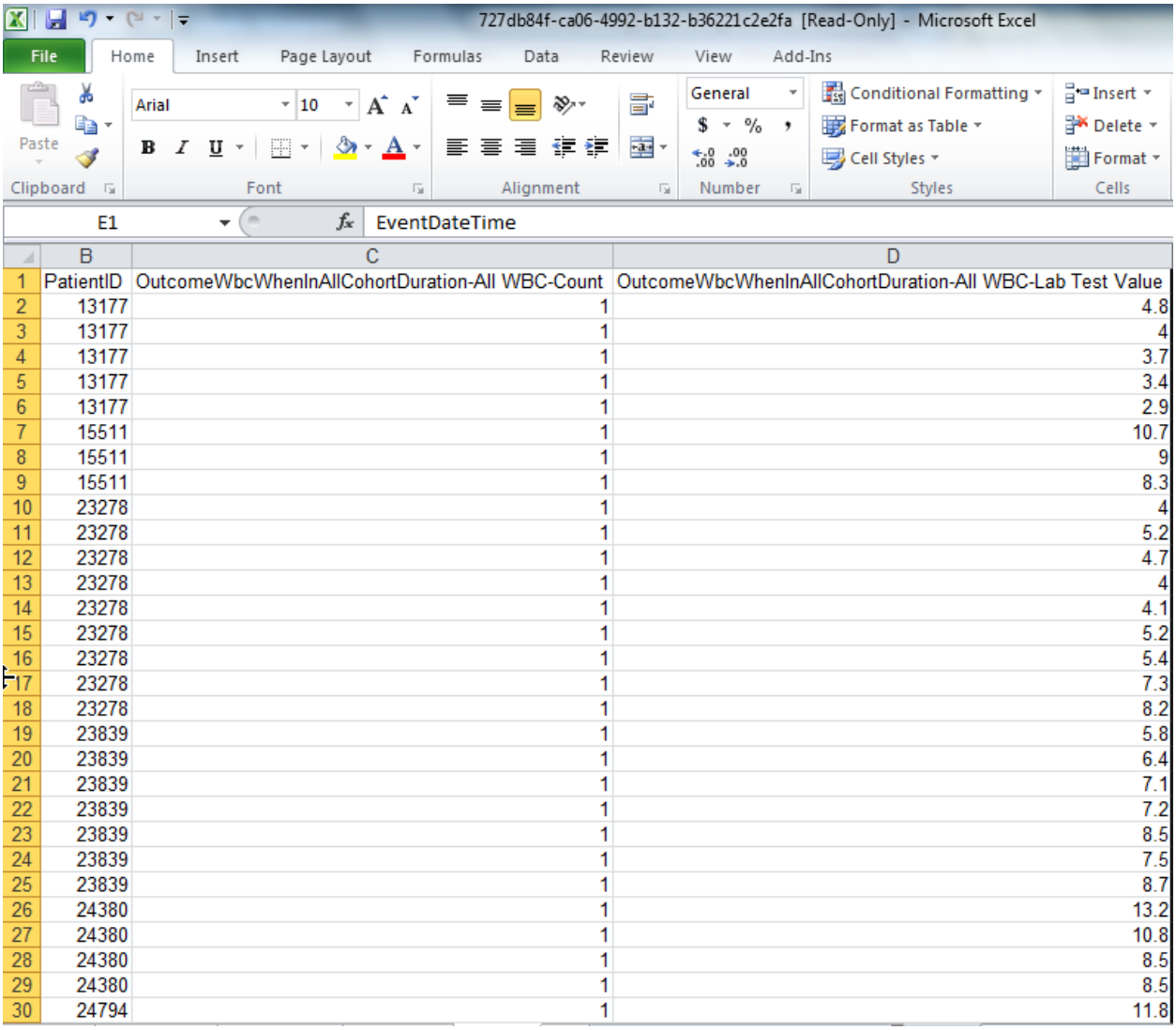
Both "Count" and "Lab Test Value" are in "Selected Attributes"



Run the method

We export to an excel spreadsheet, and have eliminated some columns.

Resulting in:



	B	C	D
1	PatientID	OutcomeWbcWhenInAllCohortDuration-All WBC-Count	OutcomeWbcWhenInAllCohortDuration-All WBC-Lab Test Value
2	13177	1	4.8
3	13177	1	4
4	13177	1	3.7
5	13177	1	3.4
6	13177	1	2.9
7	15511	1	10.7
8	15511	1	9
9	15511	1	8.3
10	23278	1	4
11	23278	1	5.2
12	23278	1	4.7
13	23278	1	4
14	23278	1	4.1
15	23278	1	5.2
16	23278	1	5.4
17	23278	1	7.3
18	23278	1	8.2
19	23839	1	5.8
20	23839	1	6.4
21	23839	1	7.1
22	23839	1	7.2
23	23839	1	8.5
24	23839	1	7.5
25	23839	1	8.7
26	24380	1	13.2
27	24380	1	10.8
28	24380	1	8.5
29	24380	1	8.5
30	24794	1	11.8

Some comments:

Column B with patient ID demonstrates that some patients have multiple rows. This means that they have multiple Wbc values from their hospitalization available for review.

Column C we see a count on each row equal to 1, meaning there is only one observation per row.

Column D are the actual white count values.

Next Steps

In Class exercise – Gatifloxacin (see handout). Does it cause dysglycemia?

Review the help manuals

Review the videos.